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# USSR Report

MACHINE TOOLS AND METALWORKING EQUIPMENT



FOREIGN BROADCAST INFORMATION SERVICE

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USSR REPORT  
MACHINE TOOLS AND METALWORKING EQUIPMENT

## CONTENTS

## INDUSTRY PLANNING AND ECONOMICS

Industry Official on Automation in Latvian Machine Tool Industry (Mikhail Shkabardnya Interview; SOVETSKAYA LATVIYA, 25 Nov 83).....	1
High Technology, Manpower Displacement in Latvian Industry (L. Korenev; SOVETSKAYA LATVIYA, 7 Jan 84).....	4
Low Capital Equipment Utilization Noted in Ukrainian Industry  (RABOCHAYA GAZETA, 17 Mar 84).....	7
Ministry Officials Reprimand Management of Cast Metals Sector  (PRAVDA, 11 Mar 84).....	10
Update on Belorussian Machine Tool Industry Modernization (V. Stepanov; PROMYSHLENNOST' BELORUSSII, No 10, Oct 83).....	12
Prospects, Status of Economic Experiment in Riga Viewed (Leonid Abramovich Mandel' Interview; SOVETSKAYA LATVIYA, 26 Feb 84).....	15
Product Mix, Management Style at Ivanovo Plant Viewed (A. Yershov, V. Sukhachevskiy; IZVESTIYA, 16 Mar 84).....	18
Ministries Urge Wider Use of Super-Hard Tool Steel (V. Gerasimov; PRAVDA, 12 Mar 84).....	26

## METAL-CUTTING AND METAL-FORMING MACHINE TOOLS

New NC Machines Raise Productivity at Odessa Plant (I. Ryabokon', et al.; RABOCHAYA GAZETA, 14 Mar 84).....	30
Modernization, Automation of Kirov Plant Reviewed (Nikolay Nikolayevich Kostikov; EKONOMICHESKAYA GAZETA, No 10, Mar 84).....	33
Modernization of Odessa Machine Tool Building Enterprises (Konstantin Mikhaylovich Manenkov; EKONOMICHESKAYA GAZETA, No 7, Feb 84).....	38
Self-Loading, Four-Spindle Turning Center Described (L. S. Pereverzev, et al.; TEKHOLOGIYA I ORGANIZATSIYA PROIZVODSTVA, No 1, Jan 84).....	42

## OTHER METALWORKING EQUIPMENT

New Plasma Cutter Developed at Ryazan Plant (Yu. Kazarin; TRUD, 18 Dec 83).....	44
Berdyansk Plant Installs Automated Shearing Line (A. L. Kolyutin, A. P. Smagach; STROITEL'NYE I DOROZNYE MASHINY, No 2, Feb 84).....	46
Briefs	
New Press	49
Multi-Spindle Lathes	49
Chemical Etching	49
Plasma Cutter	49
Precision Grinder	50

## AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

Soviet Expert on FMS, Better NC Machine Tools (P. Belyanin; PRAVDA, 6 Mar 84).....	51
Briefs	
Automated Production	55
Automated Assembly Line	55
Aggregated Machining Systems	56

## ROBOTICS

Resistance to Robots in Soviet Metallurgical Plants Noted (A. Valentinov; SOTSIALISTICHESKAYA INDUSTRIYA, 1 Feb 84).....	57
--	----



Impact of Latvian Robotics Institute on Industry Modernization	
(E. Davydenko; SOVETSKAYA LATVIA, 6 Mar 84).....	61
Belorussia's Industry Robotization Program Discussed	
(SOVETSKAYA BELORUSSIYA, 27 Jan 84).....	65
Level of Robotization of Kazakhstan Industry Viewed	
(E. Il'gerbayev; NARODNOYE KHOZYAYSTVO KAZAKHSTANA, No 9, Sep 83).....	68
Control Algorithms of Soviet HCS 'Rusalka' for Robots Analyzed	
(Andrey Aleksandrovich Petrov; POCHTACE A UMELA INTELGENCIA, No 1, Feb 82).....	75
Briefs	
Assembly Robots	91
Robot Machine Operators	91
Robot Phobia	91

INDUSTRY OFFICIAL ON AUTOMATION IN LATVIAN MACHINE TOOL INDUSTRY

Riga SOVETSKAYA LATVIYA in Russian 25 Nov 83 p 2

[Interview with Mikhail Shkabardnya, USSR Minister of Instrument Building, Automation Equipment and Control Systems, doctor of technical sciences, by APN correspondent A. Filipenko; date and place not given: "Automation Economics-Man"]

[Text] What does the introduction of automatic equipment into production and its control mean to the national economy and the worker? To this and other questions, Mikhail Shkabardnya, USSR Minister of Instrument Building, Automation Equipment and Control Systems, doctor of technical sciences, replies to APN correspondent A. Filipenko.

Delaying the results of this process which essentially is only being developed is difficult to overrate. At present, automation is the most efficient method for raising the productivity of labor and the quality of output. In the foreseeable future, it may also be said in the very near future, it will open up possibilities which only recently were written about in science-fiction novels.

[Question] You obviously have in mind the creation of unattended production facilities?

[Answer] Yes. First of all, the construction of enterprises where "self-controlled" equipment will replace man fully at all production stages, from feeding raw materials and intermediate products to warehousing and accounting for the finished products of guaranteed quality.

For example, in the instrument building sector, the first automated enterprises in the very near future will be two Moscow Watch plants. They will serve as original testing grounds for debugging methods and approaches for full or partial automation of many enterprises of the most varied sectors in the 12th Five-Year Plan period (1986-1990). This is only a small part of the facilities to be automated in the eighties: the Moscow Petroleum Refining Plant, the Kotlass Cellulose-Paper Combine, compressor stations on the Urenga-Uzhgorod export pipeline, two coal mines, a plant for manufacturing reinforced concrete plates, etc.

Our long-range problem is considerably wider. It is comprehensive automation of industry. Precisely, in this way will there be provided from the engineering side a linkage of the advantages of the socialist system with the achievements of the scientific technological revolution which Yuriy Vladimirovich Andropov, Secretary General of the CPSU Central Committee, spoke about at the June (1983) Plenum of CPSU Central Committee.

[Question] It seems that the number of robots and manipulators at enterprises determines more and more the degree of automation, as well as of the technical development of the country's industry in general.

[Answer] Unquestionably. Instrument building enterprises may give an idea of the increase in the number of robots used in our industry. In 1982 alone, we installed over 1000 robots and manipulators. This year their number will increase to 4000 and in 1986, they must be introduced practically at all enterprises of this ministry, besides about 700 of the so-called robot equipment complexes which will be in operation.

But I would like to stress that not only and not how many robots determine the technical standard of industry today. The rates and scales of automation of technological and managerial processes depend, first of all, on the introduction of microprocessor computer equipment at all levels. It is precisely microprocessor equipment and maximal experience in its introduction that opened up possibilities for changing over from the automation of individual operations to the automation of technological complexes and entire enterprises.

[Question] What economic effect will the reequipment of enterprises on the basis of microprocessor techniques have?

[Answer] I will show this on an example of the sector in which I work. In the two years of the current five-year plan period alone, we increased capacities by over 650 million rubles due to such reequipment. This year, we expect an increase of 350 million rubles more. The introduction of new equipment in the sector will make it possible for us to free over 120,000 people conditionally in this five-year plan period.

Robots and manipulators will arrive at our enterprises to replace people in sections where the work is hard, monotonous and does not require high skills, as well as in production processes with harmful working conditions. Unlike capitalist countries, we do not fire people from enterprises, but they acquire, as a rule, more interesting and higher paid specialties. In fact, our enterprises are not only improved, but also expanded and are growing. This is the social aspect of the consequences of automation in our instrument building sector, as well as in other sectors of the national economy of the country.

By the way, here is something about the sector close to you -- printing. I know that many printing houses in our country have changed over to phototype-setting. Yet, try to find a linotype operator! He is still in the shop.

[Question] At the "Avtomatizatsiya-83" International Exhibit in Moscow this summer, the latest achievements of scientific technological process were shown. In fact, they surely are not easily achieved. Are there difficulties and problems here?

[Answer] Of course. For example, there is a situation at present where producing new equipment is slowed not by a lack of achievements and engineering ideas, but the length of time and not always satisfactory quality of their realization in design-technological development. There is so far a serious gap in the increase of labor productivity in the area of production and the area of design. Modern microprocessor equipment makes it possible to develop automated design systems (SAPR) which shorten the time and labor-intensiveness of planning-design work greatly. We decided to show such a system at the exhibition and we did not make a mistake: much interest was shown in it. I want to stress that 100 such systems will be introduced in enterprises of our ministry in this five-year plan period.

2291

CSO: 1523/150

## INDUSTRY PLANNING AND ECONOMICS

### HIGH TECHNOLOGY, MANPOWER DISPLACEMENT IN LATVIAN INDUSTRY

Riga SOVETSKAYA LATVIYA in Russian 7 Jan 84 p 2

[Article by NOVOSTI PRESS AGENCY economic commentator L. Korenev: "The Sphere of Creative Labor Is Expanding"]

[Text] The miniature silicon crystal (measuring 5 X 5 mm) promises mankind extraordinary possibilities. The first microprocessor based on it was built only 12 years ago, in 1980 about 250 million microprocessor systems and devices were being used in the world, while by 2000, according to the predictions of specialists, their number may come to 5-10 billion.

In the opinion of prominent Soviet scientist Academician Guriy Marchuk, in the foreseeable future microprocessors and microcomputers will find application in more than 200,000 different types of devices and units of industry and household equipment.

Much attention is being devoted in our country to the introduction of the innovations of scientific and technical progress in production. In a speech at the June (1983) CPSU Central Committee Plenum Comrade Yu. V. Andropov said: "Immense work on the development of machines, devices and processing methods of both today and tomorrow awaits us. The automation of production has to be accomplished, the most extensive use of computers and robots and the introduction of a versatile processing method, which makes it possible to change over production rapidly and efficiently to the making of new products, have to be ensured."

Here are several facts which show what is being done in our country in this direction.

Robots. The USSR belongs to the group of leading countries in their use. They are operating in space, at nuclear electric power stations and on the assembly lines of motor vehicles and timepieces. Robots are being developed for agriculture and coal mines. During 1983 alone more robots were produced in our country than during the entire 10th Five-Year Plan. Moreover, we are carrying out robotization in cooperation with the other CEMA member countries. It is anticipated that by 1990 their total fleet of robots will come to 200,000.

Microprocessors. As compared with 1980 the number of computer complexes based on microprocessors will have increased by eightfold in 1985. During the 12th Five-Year Plan (1986-1990) their use will increase by another ninefold.

Versatile Automated Works (GAP). The complexity and importance of the development of versatile automated works, in the opinion of specialists, are comparable to the problem of the development of space and require significant expenditures. But then by means of versatile automated works it will be possible to increase labor productivity by tens of times, while having decreased in so doing the number of production workers to one-thirtieth to one-twentieth.

The Mechanization and Automation of Loading and Unloading Operations. Their daily volume in the country exceeds 250 million tons. The bulk of these operations have already been assigned to machines. The further replacement of manual labor is planned. By 1985 another 900,000 people should be freed from unskilled work. By 2000 it is proposed to eliminate the manual labor of the loader altogether.

As we see, machines are replacing people in the most different spheres. Of course, the total share of manual labor in industry, transportation, agriculture, trade and services is still very significant. While for several occupations it is simply natural (although quite recently robots were incorporated even in such a "purely human" process as jewelry making). But the overall trend and the direction of efforts at the decrease of manual labor are clear. And, hence, people are being freed everywhere.

Nevertheless, this will not create in the country the threat of unemployment, be it temporary, for the period of structural reorganization. Moreover, a constant shortage of manpower resources is being observed in our country, which in general is posing quite serious problems for the economy.

Strictly speaking, this is the "inverse effect" of the high level of employment in the country. A planned economy develops without recessions, and therefore it needs a constant influx of new workers. But a person chooses a place of work by himself. And, for example, young people with high educational qualification do not long at all for difficult and unskilled occupations (for example, of a loader) even in case of a higher wage. However, society for the present needs these occupations.

In the absence of unemployment on a purely pragmatic level the role of the economic factor from the point of view of production discipline also decreases. But then the role of the moral factor increases, discipline depends to a greater extent on consciousness and the organization of labor. Not by chance are the collective forms of labor, in case of which the workers themselves take part in planning and the distribution of income and determine the competence of managers, becoming more and more widespread in our country. Experience has shown that in collectives with such extensive rights labor productivity is also higher.

All this naturally also affects the process of the mechanization of human labor. Social arguments enjoy priority. In other words, machines are replacing man first of all where labor is more difficult, while there are not enough



workers. And the impact, which is obtained from the introduction of new equipment, is aimed not at the decrease of the number of immediate producers of material wealth, but at the increase of the production volumes with the same number of workers.

In principle the sphere of creative labor, which requires both a higher level of education and the highest skills, is expanding for man. The studies of sociologists confirm that a leading level of education as compared with the existing needs of the national economy is characteristic of Soviet society.

Therefore it is no accident that with the introduction of new equipment in our country it is always a question of the "conditional freeing" of workers. The right to work remains guaranteed. This, of course, creates additional worries for the administration of the enterprises which are introducing mechanical "substitutes" of man. But the individual separately and society as a whole gain from the mechanization of labor from a social point of view.

As to the purely economic results, for today they are like this. The industrial worker now works in our country fivefold more efficiently than the worker of the 1950's, and the output of industrial products in the country exceeds the world production of 1950. Three-fourths of the increase of labor productivity during this time has been achieved by the introduction of the achievements of scientific and technical progress.

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CSO: 1823/171

## INDUSTRY PLANNING AND ECONOMICS

### LOW CAPITAL EQUIPMENT UTILIZATION NOTED IN UKRAINIAN INDUSTRY

Kiev RABOCHAYA GAZETA in Russian 17 Mar 84 p 1

[Article: "How Does the Machine Tool Operate"]

[Text] A powerful production potential was developed in our country during the years of Communist construction. By the start of the current five-year plan period, the cost of fixed capital in the national economy amounted to an astronomical figure -- almost 1.8 trillion rubles. It increased essentially in the present five-year plan period. Last year alone in our republic, for example, 109 most important production facilities were put into operation and, in three years, the cost of fixed capital increased by 16 percent and reached 337 billion rubles. To use this potential efficiently and economically is one of the highest priority problems; to a considerable extent the implementation of plans and socialist obligations of this year, as well as of the five-year plan as a whole will depend on its solution.

At one time, as noted in the December (1933) Plenum of the CPSU Central Committee, a movement was developed in the country on raising the shift coefficient of equipment operation. Later, it began to wane unjustifiably. In fact, here lie huge reserves for an increase in and efficiency of production and productivity of labor.

What these reserves specifically represent is shown graphically in the example of machinebuilding, one of the leading sectors of our economy. Actually, equipment here operates not over 11 hours a day and the shift coefficient is 1.4. It is planned to increase this indicator to 1.6 by the end of the five-year plan period, i.e., to obtain machine tool operation of 12 to 13 hours per day. This will make possible an increase in the output by about 15 percent and a noticeable increase in the labor productivity of the machine tool operators.

Yet, so far, these possibilities are poorly utilized and five-year plan goals are not being achieved fully. That is why it is necessary to revive the movement to increase the shift coefficient of the equipment and to obtain the largest yield from it.



Recently, the Communist Party of the Ukraine Central Committee approved the initiative of the collectives of the "Zaporozhtransformator," the Kiev "Tochelektropribor," the Kremenchug "AvtoKrAS," production associations and the Tarnopol "Vatra" and the Odessa Precision Machine Tool plants, which proposed to develop among machinebuilders of the republic a competition under the slogan "From each machine tool -- the highest yield." The experience of efficiently utilizing the equipment at these enterprises produced a rich and instructive shift coefficient much higher than the average for the sector. Thus, at "Tochelektropribor", it is 1.55; at the "Zaporozhtransformator" -- 1.57; at the Precision Machine Tool Plant -- 1.59; at the "AvtoKrAz" -- 1.72; and the "Vatre" -- 1.8.

In response to the decree of the December Plenum of the Party Central Committee, these collectives obligated themselves to increase the shift coefficient by several hundreds. A set of measures was outlined for this purpose directed toward the improvement of the organization of labor and management. Basic attention was given to organizing comprehensive start-to-finish brigades, mastering related trades, developing the servicing of a number of machine tools, and identifying surplus and underloaded equipment on the basis of certification of work positions. It is planned to replace low-productivity equipment by improved equipment, expand the number of machine tools with NC and processing centers, mechanize and automate production processes more actively by introducing robot equipment and reduce sharply the times for introducing and mastering in operation new equipment.

There is also something to learn in a number of other enterprises in the republic. An example of a really zealous attitude toward equipment is the Dnepropetrovsk Combine Plant imeni Voroshilov. Working according to comprehensive regional management system to control the output quality and the efficient utilization of resources, the enterprise introduced a compulsory annual certification of work positions according to the rules of the scientific organization of labor. As a result, in three years about 600 work positions were reduced with an increased production output; in other words, without special capital investments the plant found large labor reserves; over 450 machine tools and mechanisms were dismantled and sold to other enterprises for 3.5 million rubles. The output-capital ratio increased noticeably, it is 2 rubles 96 kopecks per ruble of the fixed capital cost, or twice that of the average in agricultural machinebuilding enterprises. The shift coefficient increased to 1.53.

The experience of the combine builders became the property of many collectives. Due to the certification about 10,000 work positions were reduced since the start of the five-year plan period at enterprises and production associations of the Dnepropetrovsk Oblast. This is what it means to work competently and purposefully.

The party, Soviet, trade union, Komsomol organizations and enterprise managers must utilize the experience of leading collectives skillfully, develop specific organizational and political work to insure fuller utilization of existing production equipment and raise the shift coefficient of its operation. It should be started with work position certification, removal of surplus machine tools, greater specialization of shops and sections, introduction of order in production planning and its regular supply with material resources, and sequential and well-thought-out use of brigade forms for labor organization. It is necessary to explain clearly to each worker that equipment is our common riches and that we must obtain the maximum yield from it.

This concerns especially those enterprises where the shift coefficient is still low and where it not only is not raised but actually lowered. There are many such examples. Thus, at the Khar'kov Tractor Plant, the number of machine tools increased by 9 percent in 1980-1982, while the shift coefficient dropped from 1.5 to 1.41. As compared to 1980, this indicator dropped as follows: at the L'vov "Avtopogruzchik" Production Association from 1.56 to 1.36; at the Novograd-Volynsk Agricultural Machinery Plant from 1.54 to 1.28; at the Lkhvitsk Instrument Building Plant from 1.4 to 1.09.

At the same time, possibilities for the more efficient utilization of the production potential and increasing the yield of fixed capital exist in each collective. Taking this into account, the workers of the republic adopted for this year the obligation "Increase the shift coefficient of metalworking equipment in basic production to 1.5. Develop widely the movement for accelerated mastering of capacities and the achievement of rated labor-intensiveness.

The development of competition under the slogan "From each machine tool -- the highest yield," will, without question, also facilitate the successful fulfillment of the other most important obligation -- to raise the productivity of labor by one percent and reduce production cost of products by half a percent above the plan.

2291

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## INDUSTRY PLANNING AND ECONOMICS

### MINISTRY OFFICIALS REPRIMAND MANAGEMENT OF CAST METALS SECTOR

Moscow PRAVDA in Russian 11 Mar 84 p 3

[Article: "They Made Them Strictly Accountable (In the USSR Committee of People's Control)"]

[Text] Foundry work is one of the most labor-consuming processes. Automation and mechanization and especially needed here. For this the Scientific Production Association for Foundry Machine Building (VNIilitmash) and the Soyuzlitmash All-Union Production Association were set up in the Ministry of the Machine Tool and Tool Building Industry.

However, these subdivisions are fulfilling their tasks unsatisfactorily.

According to the data of 60 enterprises of 10 ministries, 1 model in 3 of the foundry equipment installed there has serious production and design defects. The automatic lines are especially unreliable. Due to frequent breakdowns their idle times amount to 30-50 percent of the operating time. Last year alone for the replacement of defective assemblies new ones worth nearly 800,000 rubles had to be produced.

The reliability index of the automatic lines, which were designed and produced by the VNIilitmash, comes to only 0.32-0.75 as against 0.93 for the best analogues. Individual parts of such lines fall apart at the works under the first loads, many assemblies constantly jam. For the elimination, for example, of the defects of the line at the Rustavi Tsentrolit Foundry 316,000 rubles had to be spent, while this is equal to 27 percent of its cost.

But instead of straightening things out, General Director of the VNIilitmash I. Onufriyev took the path of additional charges. Equipment, which has not undergone the necessary tests, is shipped to enterprises. Frequently the managers of the association report on the output of machines which are not yet in production.

One of the leading enterprises of the Soyuzlitmash All-Union Production Association--the Novosibirsk Plant of Casting Machines and Automatic Lines--is supplying foundry equipment with a large number of defects. Of the 10 automatic machines in the past 2 years serious defects have been found in 9.

The proper control of the quality of the products being produced is absent at the enterprise. The welding operations are being performed haphazardly, with- in complex assemblies it is possible to find fragments of electrodes.

Many irregularities were detected at the Usman, Volkovysk and Pavlograd Plants of Foundry Equipment, as well as the Ivano-Frankovsk Avtolit mash Plant of Automatic Casting Lines and the Pinsk Production Association. However, N. Se- menov, chief of the all-union production association, did not take the neces- sary steps for the elimination of the defects. Of the 92 models of advanced casting machines, which were envisaged for assimilation in 1981-1983, the pro- duction of only 48 has started.

The committee strictly punished General Director of the VNIILit mash I. Onu- friyev and recovered from him an unauthorized monetary expenditure in the amount of 800 rubles.

The attention of Minister of the Machine Tool and Tool Building Industry B. Bal'mont was directed to the low quality of the foundry equipment, which is being produced by the enterprises of the sector, and his statement that the ministry would reinforce the Soyuzlit mash All-Union Production Association, would take steps on the elimination of the shortcomings and would call to ac- count the managers of the plants, which produce low quality products, was taken into consideration.

7807

CSO: 1823/169

## INDUSTRY PLANNING AND ECONOMICS

### UPDATE ON BELORUSSIAN MACHINE TOOL INDUSTRY MODERNIZATION

Minsk PROMYSHLENNOST' BELORUSSII in Russian No 10, Oct 83 pp 40-41

[Article by V. Stepanov: "On Account of Intensive Factors"]

[Text] Machinery building has a leading role in the industry of Gomel Oblast, accounting for one-third of total production volume. Machinery building products such as self-propelled forage harvesters, drain pipe layers, multipurpose machining centers, and machine tools for welding and making piston rings are made only in Gomel Oblast. These items are not only known in our country, but also abroad, including in the United States, Japan, England, France and the FRG. The oblast's machine tool builders have important and responsible tasks during the current five-year plan. Practically all enterprises should considerably increase total production volume and master the production of new items meeting the better world and national standards. They should also sharply improve their competitiveness. All this must be done without increasing production capacity and the number of workers, through intensive factors alone.

Many large enterprises in the oblast, constantly increasing production, are successfully rebuilding. Everywhere progressive manufacturing operations and equipment are being introduced and the technical standards of products improved. In particular, machinery builders have completely ceased the production of output in the third category of quality.

At the oblast's enterprises there is widespread support for the initiative by the collective at the measuring instrument plant in Gomel. It essentially consists in seeing that all production growth during the 11th Five-Year Plan take place without increases in the number of workers. This has resulted in higher labor productivity growth rates in machinery building and in considerable reductions in requirements for labor.

There is also fervent support for the initiative by the collective at the Machine Tool Building Plant imeni S. M. Kirov in Gomel: "Work without lagging, complete all orders on time and at high technical standards". The rhythm coefficient exceeds 0.9 at this enterprise, which produces complex equipment in relatively small series. It has completely met its delivery plan, although the assortment of products made exceeds 1,000. The Gomel machine tool builders receive practically no complaints.



Also deserving of attention are the intelligent organization of engineering work, concern about the development of workers' creative activities and the well thought out use of internal reserves. All this can be done at any enterprise in any sector. This is why the dissemination of better experience is an urgent task for oblast and city leaders.

Especially valuable experience has been acquired in the reduction of manual labor. This, in particular, has been spread by the party obkom and has become the starting point for all enterprises in Gomel Oblast. Take, for example, the classification of work places. This has now been done for more than 20,000 of them, making it possible to find and utilize sizable reserves involving the release of workers and the increased efficiency of public production. All enterprises have developed targeted comprehensive programs for the reduction of manual labor (TsKP), which became the main oblast program.

Here are some results from this work. In the oblast's industry today 58.4 percent of workers are engaged in mechanized labor and 28.6 percent in manual (in 1975 these figures were 52.7 and 35.9 percent). One out of eight enterprises has comprehensively mechanized all basic production operations. Mechanization levels are 70-80 percent at plants such as the Kirov, machine tool component, electrical apparatus, starter motor, measuring instruments, and Hidroprivod. The oblast's industrial enterprises annually release 1,500-2,000 people, while the labor of 8,000-9,000 is significantly lessened.

The universal introduction of robots is a distinctive feature of the present stage of production mechanization and automation. Machinery building enterprises are setting the tone in this matter. Good prospects for robotization have been noted at the Kristall, measuring instruments and radio-technical equipment plants and the Gomsel'mash Production Association in Gomel. It is fundamentally important that this not be restricted to the hurried introduction of individual manipulators, but utilize long term designs and programs, striving to create valuable robotized manufacturing complexes and completely robotized sections.

As a rule, these and other enterprises are not waiting for the needed equipment to appear on the market, but are being self-reliant. For example, half of the automatic lines operating in the oblast's industry were manufactured here (mainly at machinery building enterprises). The implementation of the 11th Five-Year Plan's measures will make it possible to release an additional 7,000-8,000 workers, 20 percent, of those engaged in manual labor. The elimination of heavy and harmful operations on such scales will make it possible to provide personnel for new and expanding enterprises without removing labor resources from agriculture and other sectors.

Unfortunately, the enterprises themselves are by no means capable of solving all the problems. The manufacture of mechanization and automation equipment at specialized plants is still lagging behind the oblast's needs and orders for new, progressive equipment are far from completely met. Things are also being delayed by incomplete deliveries. This is the reason it is difficult to combine machine tools into mechanized-flow, automatic and semi-automatic lines.

The mechanization of a modern production operation is a difficult design, technological and organizational task. The active development of collective forms of creativity and the creation of brigades with engineers and skilled workers are

important in this regard. About 2,000 such brigades have already been created in Gomel Oblast. Last year alone they implemented about 6,000 measures, a third of which were directed towards the reduction of manual labor.

Gomel's scientific-production associations have also proven themselves well in the solution of difficult technical problems. The experience of Lvo' Oblast in the creation of scientific-production complexes is now being studied. This will help in speeding up the implementation of scientific ideas. With this purpose in mind, last year the party obkom supported the initiative of specialists at the Belorussian Academy of Sciences' Institute for the Mechanics of Metal Polymers (in Gomel) for conducting a review of enterprise scientific-technical levels under the slogan: "The progressive solutions of scientists and specialists applied to production problems". It is planned to form plant scientific sectors at the oblast's largest enterprises in order to facilitate the practical introduction of new developments.

The construction and reconstruction of many enterprises in the oblast is being completed in the 11th Five-Year plan. Unfortunately, this work often used obsolete designs and, what is most intolerable, is based on incomplete technology requiring the use of manual labor.

Program targeted planning is an effective means of fighting such "innovations". However, there is not yet a unified methodology for reducing manual labor. For example, initially all enterprises worked out targeted comprehensive programs for 1981-1985 using the methodology of republic Gosplan and Goskomtrud [State Committee on Labor and Wages]. A short while later they had to compile new, repetitive documents using sector methodologies with different principles and goals. There were no report forms for these programs, hindering the management of processes on a regional scale.

As is known, problems in scientific and technical progress have territorial peculiarities. They are influenced by the existing production structure, scientific research and planning design organization and VUZes, relations between national and local enterprises, and other factors. The problem of the unequal potentials of enterprises for scientific and technical policy implementation is quite serious and should therefore be taken into consideration. Unfortunately, territorial organs are often in a very difficult situation. Interdepartmental barriers are especially evident. Thus, even though the oblast has a developed machinery building sector, it is impossible to organize the manufacture of the simplest devices for automation and mechanization on an intersectorial basis. Orders for scarce spare parts for agricultural machinery were only filled with difficulty. Obviously, this problem must be solved in a planned manner, perhaps through economized resources.

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## INDUSTRY PLANNING AND ECONOMICS

### PROSPECTS, STATUS OF ECONOMIC EXPERIMENT IN RIGA VIEWED

Riga SOVETSKAYA LATVIYA in Russian 26 Feb 84 p 4

[Interview with Candidate of Economic Sciences Leonid Abramovich Mandel', Deputy General Director of the Order of Lenin Rizhskiy elektromashinostroi-tel'nyy zavod Production Association, by P. Antropov: "The Experiment Is Teaching to Manage"]

[Text] A number of enterprises of our republic are taking part in a large-scale economic experiment which began on 1 January of this year. The collective of the Order of Lenin Rizhskiy elektromashinostroi-tel'nyy zavod Production Association, which was declared the winner of the All-Union Socialist Competition in accordance with the results of the past year, is also among its participants. It was awarded the Challenge Red Banner of the CPSU Central Committee, the USSR Council of Ministers, the All-Union Central Council of Trade Unions and the Komsomol Central Committee with placement on the All-Union Honor Roll of the Exhibition of USSR National Economic Achievements. The work, which was performed at the enterprise on the preparation for the experiment, also played an appreciable role in the achievement of this success. Its performance this year promises an even greater impact.

Today the peculiarities of the work of the collective under the conditions of the experiment are arousing the valid interest of the workers and other enterprises of the republic. We asked Candidate of Economic Sciences L. Mandel', deputy general director of the REZ [Rizhskiy elektromashinostroi-tel'nyy zavod] Association, to tell how the experiment began and what advantages it will give the collective.

[Question] First of all, Leonid Abramovich, I would like you to explain, for what are such economic experiments necessary and what is it planned to check during the next one of them?

[Answer] Modern production is a complex economic mechanism, in which thousands of enterprises and tens of departments and ministries are closely interconnected. This mechanism is constantly being improved and updated. But in



order not to hinder its operation and to find the most reliable means of further development, economic experiments are also conducted. The experiment, in which we are participating, envisages the further broadening of the rights of production enterprises in planning and economic operations, as well as the increase of their responsibility for the end results of the work.

[Question] Figuratively speaking, is this a check of the ability to manage independently, without petty guardianship on the part of the sectorial ministries?

[Answer] It is also possible to agree with such a formulation. The experiment is called upon to help those collectives, which know how to manage and to show the untenability of the conclusions of those workers who justify their lack of skill by shortcomings in planning and material and technical supply.

[Question] Tell me, please, in greater detail about the new procedure of planning.

[Answer] The enterprise has received the right for the 9-10 months until the start of next year to coordinate independently with the organs of the USSR State Committee for Material and Technical Supply the planned need for its products and not simply in the total amount, but also strictly according to the products list. This need will also constitute the basis of the assignment which the sectorial ministry is obliged to review no later than May. And this means that the enterprise will obtain the opportunity to draw up precise and timely orders for materials and component items. It will have more time for the preparation of production for the assimilation of new items and for the making of other economic maneuvers.

Such a procedure of the planning of the products list at the same time will save the enterprises unnecessary troubles, which are connected with the sale of products which previously they produced at times for the increase of the gross indicators. Now the enterprise first of all will worry about the fulfillment of the assignments on deliveries. This is entirely justified, for the main goal of our socialist production is not the pursuit of gross indicators, but the filling of the quite specific orders of related industries and trade. The fulfillment of these assignments on deliveries in the full amount will enable the collective to increase the material incentive fund by 15 percent. And the material liability is no less--for each percent of nonfulfillment of the assignment on deliveries the fund will be decreased by 3 percent. For our collective this is equivalent to a decrease of the bonus fund by 60,000 rubles.

[Question] Under the conditions of the experiment is the procedure of the formation of the fund itself also being changed?

[Answer] That is quite correct. Previously the sectorial ministry usually established its amount and for a long time the amount of the fund did not change substantially. It stimulated little the increase of the efficiency of work. Now the amount of the material incentive fund depends entirely on the collective, on its ability to be the manager of production. Starting this year the material incentive fund here will be increased by 5 percent for each

percent of the decrease of the expenditures per ruble of commodity production. In short, the fewer the expenditures are, the larger the incentive fund is. This year we are planning to increase it by approximately 200,000 rubles. True, it will be necessary to do a fair amount of work in order to decrease the amount of expenditures by 1.6 percent, or nearly 1.5 million rubles. And a practical approach to the work promises great benefits for the collective. For example, the decrease of the expenditures per washing machine by just 15 kopecks will make it possible to increase the incentive fund by 10,000 rubles.

The procedure of forming the fund for sociocultural measures and housing construction has also been changed. This year its increase will depend entirely on the increase of labor productivity. Thus, the material stimuli under the conditions of the experiment are inducing both the collective of the enterprise and each worker to observe rigorously the discipline of deliveries of products and to try to produce more goods items with fewer expenditures.

However, successes will not come by themselves and can be achieved only on the basis of the acceleration of scientific and technical progress and the increase of the output at each workplace. Therefore at our enterprise the new rights and opportunities are supported by a comprehensive plan of the introduction of new equipment, the perfection of the manufacturing method, the improvement of the organization of operations and the introduction of advanced methods of labor. According to the most conservative calculations, its fulfillment will make it possible to save this year 1.77 million rubles and to conditionally release 250 people.

[Question] Obviously, you have already analyzed the results of the first month under the conditions of the experiment.

[Answer] Yes. And if one puts it briefly, they are living up to our expectations. Although January was difficult for many works--the related industries seriously let them down--the enterprise fulfilled the assignments on all the indicators planned by us. While the growth rates speak for themselves: the output of commodity production increased by 10.7 percent, while labor productivity increased by 9.5 percent.

True, it must also be taken into account that the preparation for the experiment in the ministry and interested departments at our enterprise was begun only at the end of last year. This has not made it possible yet to ensure the balance of the plans of production and supply, which is necessary for the complete success of the experiment. And at our enterprise not all the units of production are sufficiently ready yet for it. All this, of course, for the present is decreasing the impact of the commenced reorganization. But today it is already entirely safe to say that the new experiment will be of much benefit to our economy and, of course, the collective of the REZ Association, at which the number of its supporters is increasing with each day.

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## INDUSTRY PLANNING AND ECONOMICS

### PRODUCT MIX, MANAGEMENT STYLE AT IVANOV PLANT VIEWED

Moscow IZVESTIYA in Russian 16 Mar 84 p 2

[Article by IZVESTIYA special correspondents A. Yershov and V. Sukhachevskiy: "A Justified Risk"]

[Text] 1. There Is No Time to Lose Time

The sun of glory rose over the Ivanovo Machine Tool Building Production Association imeni 50-letiya SSSR some how suddenly and instantly. Some 7-5 years ago they were not fulfilling the plan here. According to our customary measurements and ideas this was a lagging works. However, Vladimir Pavlovich Kabaidze, general director of the association, asserts very forcefully that there is a dialectical relationship between yesterday's nonfulfillment of the plan and today's success. The Ivanovo workers have proven once again the interdependence and mutual influence of quantity and quality. They seem to have filled dispassionate philosophical categories with stunning material results.

The director is not simply philosophizing. In confirmation of his thoughts he recalls not without pride that the association in accordance with the results of the work last year was awarded the Challenge Red Banner of the CPSU Central Committee, the USSR Council of Ministers, the All-Union Central Council of Trade Unions and the Komsomol Central Committee with placement on the All-Union Honor Roll at the Exhibition of USSR National Economic Achievements. Well-known American, Japanese, Canadian and West German firms are willing purchasing the products of the Ivanovo workers--machining centers and NC machine tools. The file of domestic orders is filled up for tens of years ahead.

Thus, there is advanced know-how. It is world recognized and has received a well-deserved appraisal of the highest management organs of the country. On the road to Ivanovo we thought about the fact that here, they say, we will see new equipment, will familiarize ourselves with the organization of its production and will write in detail about this. Everything turned out to be both more complicated and more interesting. After the meetings with the general director, the leading specialists and workers of the association it became obvious: the concept of experience as applied to the Ivanovo machine tool builders does not fit into the customary framework. Here everything seemed to us to be worthy of attention and study: the organization of the work, the attitude of the workers toward it, the style of management, the principles of the interrelations of people and the people themselves.

Even the meeting with Kabaidez took place not in the way that such meetings take place. There were not warnings to the secretary "do not put through anyone's calls, do not let anyone in." During our conversation they looked in on him and called. But it was felt: these were only urgent matters. It was sensed very keenly that the outward office decorum had long ago and permanently given way here to an extremely businesslike, intensely responsible style of work. As Boris Antonovich Chekalov, chief process engineer of the association, accurately noted, "we do not have time to lose time."

Kabaidez immediately set the pace and tone of the conversation.

"If the number of contracting brigades, the number of shock workers and the plan of measures on the certification of the workplaces interest you, we will prepare such data for you. But I would not like to waste time on this. The admiration of quantity here has dragged on too much.

"How many machine tools are produced in a year in the country? Some 200,000. In order to use them during two shifts, it is necessary to find annually 400,000 workers. Where is one to get them, I ask you? But now another question: What do we need 200,000 machine tools annually for, if many of them are idle?

"We immediately set out in a different direction. We began to make super-modern machining centers, which in the ultimate national economic efficiency exceed by many times ordinary machine tools. We introduced an indicator-- 'the output of the latest products.' It is interpreted as follows: first, not to modernize preceding models, but to develop fundamentally new ones, of several times greater productivity. Second, the machine should exist a maximum of 7 years from the stage of designing. By this time it becomes obsolete. And, third, it should be competitive on the markets of the developed western countries. We have now achieved this."

#### Notes in the Margins of the Notebook

The production of the latest equipment (which conforms to the parameters which were listed above) amounts at the association to 80 percent of the total volume of output. For comparison: for Ryazan machine tool builders this indicator is equal to 1.5 percent, for Leningrad machine tool builders--1 percent, for the remaining plants of the sector--less than 1 percent. The Ivanovo workers supply 90 percent of the science-intensive (that is, conforming to the latest achievements of science and technology) machines, while all the other 300 plants of the Ministry of the Machine Tool and Tool Building Industry provide 10 percent. The products of the association are being sold to developed capitalist countries for freely convertible currency.

We, it must be said, sensed a certain bewilderment: everything is obvious, logical, about what dialectical contradictions in their unity was Kabaidez speaking at the beginning of our conversation?

"What is incomprehensible here?" Vladimir Pavlovich sighs. "They plan for us the output of ordinary machine tools, while we, instead of making equipment of the day before yesterday, are putting into production machining centers which



are unprecedented in the country. This was not planned for you, they make a stir, kindly do what was ordered!"

"They violated, it turns out, discipline?"

"And how!"

"They caught it? Were they able to free themselves?"

"They were able to. The fights were serious."

"Frankly, Vladimir Pavlovich: if you were to start from the beginning, but with the store of today's experience, what would it have been possible to avoid?"

"It would have been possible to save the 5 years which went for agitation for new equipment, for the proof of its necessity. It was necessary, having weighed everything, to move forward without looking back, to prove the advantages of new machines by the machines themselves. Indeed, we were able to fulfill the plan on the production of unnecessary machine tools and were able to live in peace and in a care-free manner. But then the country would not have now high class machining centers. I will note at the same time that it is possible to make many types of products only on our machines."

We asked the question, as they say, point blank: Everything is so clear and convincing, why was it necessary to overcome strong resistance and how in this case did the head remain intact?

Kabaidez smiled slyly. He said calmly that one should not understand the complicated processes of technical progress as the struggle of one hero warrior against a dark force. The opponents of the new direction in machine tool building, after all, also had arguments. And Kabaidez did not remain alone. Many remember when the director of the enterprise, which was not fulfilling the plan, sat in the presidiums of oblast conferences, while "successful" managers were not awarded such an honor. The Ivanovo Oblast Party Committee actively supported the innovators, their bold actions were attentively followed in the CPSU Central Committee. In general a favorable atmosphere was created for an engineering and organizational risk.

Kabaidez reflects:

"Rembrandt painted a picture--it is possible to admire it for 1,000 years. It will not bore and will not become obsolete. And the fame does not fade. But what about us? We have a different fate. I was carried away 5 years ago by a new machine tool. A miracle, and not a machine! Now I look at it as a primitive item, the place for which is in the dump. There are things in life, which do not depend on the passage of time. It happens that one must not fall behind it. The machine tool builders have a different lot: they are obliged to be ahead of the times. How one is to achieve this is a special subject.

"Imagine the following situation. A patient comes to the physician and says: I need to have two shots intermuscularly, one intravenously and also preferably

a massage. Is it funny? At one time we were in the position of such a physician. The client comes and puts the technical documents on the table: it is necessary, he says, to do thus and thus. Now, it must be said, such 'patients' do not come to us. The relations with the client are being organized on a fundamentally new basis. We study his problem. We formulate an idea. And we suggest a method of solution. It is impossible otherwise. It is impossible to deal with electronics and a laser and to preserve 30 year old methods of work."

#### Notes in the Margins of the Notebook

The Ivanovo machine tool builders work without a warehouse--they work exclusively for the client. A network of cooperation has also been formed from the client. It is supported not by a vertical basis (the contract--monitoring--the arbitrator--penalties), but by a horizontal basis--by the interest in obtaining single-design machines with the stamp "Ivanovo."

Kabaidez is convinced: it is necessary to produce in a year not 200,000 machine tools, but, let us assume, 75,000. But those kinds which by productivity would offset the quantitative difference. He reasons as follows: 200,000 traditional machine tools are approximately 200,000 tons of cast iron, while 75,000 advanced machines (they are slightly heavier) are on the order of 100,000 tons of metal. The saving is one-half. While the "extra" 100,000 tons are the wasted productivity of mine workers, metallurgists, transportation workers, engineers and so on and so forth.

We have the right to be proud of the achievements of the scientific and technical revolution. But of what kind of revolution in machine tool building can it be a question? In the sector everything, Kabaidez asserts, has been penetrated by obsolete ideology. Here is the simplest illustration for you. The Ivanovo Association produces the latest equipment, which signifies a fundamentally different, truly revolutionary approach to the organization of modern production. And they themselves are working on such equipment, by the same advanced methods. At the same time the Ministry of the Machine Tool and Tool Building Industry each year with a persistence, which is worthy of better use, plans for them the introduction of various flow lines and general-purpose machine tools. That is, it is doing what is radically at variance with the basic idea of the innovators.

#### 2. The Main Idea of Kabaidez

It is always crowded in the waiting room of the general director. Clients fly and ride to Ivanovo from all corners of the country. If you were now to triple the price for the machining centers, the line would not decrease.

"So, Vladimir Pavlovich, the difficult time for the collective is over. Your main idea--to make modern equipment on modern equipment and by modern methods--is triumphing. About what is the concern now?"

"Not to get fat. People, who have been spoiled by flattery and smothered with kisses, have never created anything. And they will not. Recognition is, on the hand hand, good and gratifying. On the other, it is dangerous. Because fame (and it is also an entirely material thing) has inertia. If you gave in

to it, everything came to nothing. If, as happens, for long years esteem and applause were programmed for you, stagnation begins. Therefore, having achieved the goal, it is necessary to set without fail a new, higher one."

Here is what it is necessary to dwell on and think about here. The stand of the director seems to be attractive. It seems to recruit allies. But let us image ourselves in the place of his subordinates. A race. A desperate race! Without intermediate finish lines. Will everyone stand up?

"Not everyone," Kabaïdze says firmly. "But not everyone should be in our business. But this does not at all mean that we, when producing complicated automatic machines, are ourselves turning into heartless machines. Not at all. In the collective a truly creative spirit reigns, the emotional charge of people is very high. Everything is subordinate to eager, inspired work. The remainder has somehow receded by itself into the background. When it was especially difficult for us, when they frequently flogged us on business and not on business, some people left. I believe that the weak-nerved left. The strongest survived."

Kabaïdze laughs: Darwin's theory was also confirmed here. There also formed in this way a collective of like-minded people. Even fanatics, it can be said. But there are many temptations around. Two Ivanovo adjusters--aces, first-class experts--once went to one of the Ukrainian plants. Now they also enticed them there. They offered apartments, a good wage. There it is warm, there are many fruits, there are vacation centers, there are sanatoriums. They stayed. But after 2 years they came and are asking to be taken back. Back before this case Kabaïdze issued his law: deserters are not to be hired. But here it is another matter: the specialists are exceedingly good! And they had repented quite sincerely. Verily, man does not live by bread alone.

On the whole, they hired them back. Kabaïdze did not decide this himself. The workers' meeting decided.

#### Notes in the Margins of the Notebook

Last year the production volume at the association increased by 19.1 percent. Labor productivity increased by 18 percent. These indicators are threefold greater than the average indicators for the sector.

The high growth rate of production was achieved by means of the output of highly efficient machining centers. Moreover, without new construction with the former number of workers. In other words, the renovation and retooling of shops proved to be the most efficient, economically advantageous means. Whereas the value of the fixed capital at the association increased from 35 million rubles in 1970 to 55.3 million rubles in 1983, the output of commodity production during this period increased respectively from 21 million rubles to 72 million rubles. Not one enterprise of the sector can boast of similar indicators.

In the socialist obligations of the collective of the association it is recorded: in addition to the plan of this year to increase labor productivity by 2 percent, to produce by means of this products in excess of the assignment

worth 2 million rubles, to decrease their production cost by 0.6 percent. The Ivanovo workers are firmly keeping their word. During the first 2 months of the year they increased labor productivity by 5.7 percent and produced above-plan products worth 1.33 million rubles, while having decreased their production cost by 0.1 percent.

They are working confidently. Each person knows his job. Here the content of labor and the form of its organization are surprisingly fundamentally, naturally coordinated. Here, let us say, is the brigade method. At the association no one imposed it on anyone. Life itself made the necessary adjustments. There was the following case. They assembled a machining center. They assembled it on time, as expected. But then for half a year they could not send it to the client--they were not satisfied with the test results. But it is not that easy to find a defect in a multiton machine, which is saturated with electronics and automatic systems.

Now one brigade carries out the assembly of a machine tool from screw to screw. We saw how the young fellows from the collective, which USSR State Prize Winner Aleksandr Kostin manages, work. Accurately, precisely, carefully. And they turn over the machine turnkey.

However, Kabaidze speaks about all this not as if readily, but some how in passing, incidentally. Again and again he returns to his main idea: domestic industry has enormous possibilities for quick progress.

No one argues that it is necessary and essential to pick up the reserves which lie under foot. But again let us take, he says, machine tool building. Everyone is convinced of the enormous efficiency of machining centers of the highest class. But they are making them for some reason only in Ivanovo. Other plants are chasing equipment of yesterday, or else the day before yesterday. Now no one is arguing with Kabaidze, everyone agrees (for he proved it by deed!) and nods his head significantly, but as before thousands of machine tools, which are holding back technical progress, are coming off the plant conveyors.

What is the reason? But there is no answer. They merely stated the following suggestion to us. Here, let us assume, the Gorkiy machine tool builders pondered: But should we not take the path of the Ivanovo workers? And immediately there are doubts: at best, in case of success, we will achieve the same thing as the innovators. And what did they achieve? World and national fame? Yes. But nothing more. In spite of repeated decisions, production is not being developed; the designers, who are developing ultramodern equipment, work under crowded conditions, which are reminiscent of the crowded conditions of old boot workshops; they are not building housing, the wage for a long time was less than the average level. The Gorkiy workers will think and think, and will stop thinking.

This kind of average distribution of gingerbread, Kabaidze believes, is also hindering the matter. But what are 300 machining centers a year? This, apart from all else, is tens and hundreds of millions of rubles, which are saved for the country. One must also give thanks more generously for such work. At the February plenum General Secretary of the CPSU Central Committee K. U. Chernenko stressed: "In general, comrades, we, apparently, should be concerned that the creative initiatives and innovation of the working people would be better stimulated materially and morally."



It was about 7:00 pm when the group of designers came to the office of the general director. They were quite young fellows. It was also awkward to call them by their patronymic. Kabaidze afterwards (when everyone had already left) actually told about them with paternal love. Serezhka Krasil'nikov, Kolya Bondarevskiy, Georgiy Bolotin. They stood around the table and discussed the problem at hand. There was neither a general director or a beginning engineer here. They were colleagues, associates. The young fellows and he, also young, eager, although 60 years are already behind him, and the war is behind him. Apparently, he had tossed them an unexpected idea. Because the discussion subsided at once, and with some aloof glances they each retired into themselves. But Kabaidze went up to his desk and as if in passing let out:

"I have received the prospectus of an Austrian firm. It is a very interesting machine tool. You pick through it and give me your views. It will be, in my opinion, useful."

#### Notes in the Margins of the Notebook

Stanislav Yevgen'yevich Gurychev is the chief engineer of the Special Design Bureau. He is 47 years old. By local standards he is an old man. The average age of the collective of the Special Design Bureau (400 people in all) is about 30. We ask him the same question: you are very crowded, the wage is no greater than at a personal service combine, there are no prospects of obtaining an apartment, what holds people?

"The work. Much, interesting work. For we are competing with the leading machine tool building firms of the world. And in many ways we have surpassed them. For us, of course, it is not simple. I remember that I brought in a young, capable designer from another plant. He seemed not yet to have been able to gain momentum, to have been able to get tired and get fat. He worked here a year and returned to his former place. He did not withstand the rhythm, the pace. And our ideology--the ideology of constant, daily and very intense research--proved to be excessive for him."

Gurychev, having interrupted himself, suddenly asked:

"Do you know what a chart of the level is? I will explain: it is a document, in which the basic parameters of our equipment are compared with the best world equipment. So, the managers of the design subdivisions usually go to the main institute to defend the chart of the level. It is usually this way. Here there is also a chart of the level. I state quite responsibly: our ordinary designer corresponds to the level of the leading designer, while our leading designer is the chief of a division or the chief engineer for any design bureau of the sector."

"Both the workers and the engineers here are first class," Kabaidze says. "But the organization of the work is no good at all. Of the 500 machine tool building plants of the FRG only 2 have their own foundry. While in our country each one does. Each makes bolts, screws and nuts for itself. Hundreds of people are working unproductively. Why not form specialized capacities? Labor productivity would increase hundreds of times. That is where one must seek the wanting percent."

He is not concerned about himself. He is concerned about the interests of the country. Indeed, the Ivanovo experience has been recognized and approved. For the development and industrial introduction of sets of highly efficient equipment a group of workers of the association, including Kabaidze, last year was awarded the USSR State Prize. The prize of the Leninist Komsomol was awarded to several workers, designers and process engineers.

It is gratifying, of course. And still it is one association in the country. Take and introduce the living experience, the most valuable experience, truly worth its weight in gold! But they are not introducing it.

And why?

Kabaidze shakes his head mournfully:

"Ask something a bit easier."

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## INDUSTRY PLANNING AND ECONOMICS

### MINISTRIES URGE WIDER USE OF SUPER-HARD TOOL STEEL

Moscow PRAVDA in Russian 12 Mar 84 p 2

[Article by V. Gerasimov, "Evaluating Innovation"]

[Text] A man comes to work and duly executes his tasks and duties accurately, and values every working minute... At the same time, he knows that there will be little benefit from his work but rather damage. In fact, there is no demand for the product he made and it will remain a dead load in the warehouse.

You can hardly think of a more absurd and insulting situation for a conscientious workers, trained to care for the final result of his labor, accustomed to the thought of its social necessity and importance. But it is precisely in this situation that the collective of the "Instrument" Plant has been for the year now.

At one time, this enterprise mastered the output of a useful and promising innovation -- a cutting tool from super-hard materials: el'bor, hexanite and composite. Cutters made of these materials are capable of machining at high speeds not only the usual alloyed steels, but also quench-hardened steels that previously could only be ground.

The labor productivity of machine tool operators increased considerably. There were a number of other advantages. Due to less force being used in the cutting, the parts do not get overheated and, therefore, are not deformed. The tool does not wear out for a long time.

This means that the adjustment accuracy is not disturbed and this is especially important when the equipment operates in the automatic mode.

It may be said that in flow lines or flexible automated production, the new tool is ideal. According to specialists, each cutter saves 5 to 25 rubles and a milling cutter saves even more -- over 100 rubles. When such a tool is used widely in metalworking, the advantage to the national economy is indeed huge.

It would seem that this innovation should be made accessible to the machine tool operators as soon as possible. Which, by the way, the machine tool and

tool industry began to do without delay. Four production facilities were organized. The "Instrument" Plant, for example, planned to increase the output of cutters made of super-hard materials by 6 to 8 percent. In 1984, it was ordered to manufacture products for almost 7 million rubles.

The problem was feasible. But the collective was confused. "How long," they thought, "will we work for the warehouse?" In fact, the tools produced last year have still not been sold. Customers for whom procurement organizations finished orders for delivery refuse even those. It is a paradox!

There is no doubt that the sector produces a progressive tool. Then why, in spite of various ways of selling it to enterprises, is there no demand for it and it lies in the warehouse for three years in a row? It was calculated in the Soyuzglavstankainstrument of the USSR Gosstab, for example, that the gap between the output planned for the plant and the confirmed industrial demand is almost 4 million rubles! It was found that over half the tools intended for the machine tool operators were not needed.

We should mention immediately that the procurement organs stated an actual fact. However, the art of management is that the duties of some are limited to stating facts, while the duties of others are to think about the facts and be stimulated to take initiatives by them. But this did not happen in time and the national economy lost an opportunity.

At the Kostroma "Motordetal" Plant an automated line for machining pistons, equipped with super-hard material cutters, saves 429,000 rubles annually. The Cheboksary Tractor Plant cannot do without them.

At the Voronezh Machine Tool Building Plant heat treated parts are now milled with high speed and are not ground slowly with abrasives as before. In a word, wherever they can use the new tool, they are used very willingly.

Very frequently, positive examples are found in enterprises that have high speed machine tools. Precisely in this situation is it possible to obtain the full effect of the super-hard materials. At the usual series production facilities of the Ministankoprom [Ministry of the Machine Tool and Tool Industry] the advantage of the expensive tools is not great, considering that their price is considerably higher than of the traditional tools. This is one of the reasons for their limited demands so far. While valuing the tools from super-high materials as a whole, technologists in a number of Leningrad plants and workers of tool services, whose opinion, one thinks, must be taken into account, indicate another reason: the tool assortment is not high. This is true. But, the Ministankoprom did not pay special attention to this fact. They approached the subject too one-sidedly, without studying the demand and making a precise forecast.

When the production of tools from super-hard materials began, the sector standard envisioned a compulsory coordination of product specimens with the basic customers before starting their manufacture. As the danger of "overstocking" arose, this condition was eliminated from the standard. Actually, it was much simpler, using given rights, not to listen to the voice of the customer. Than

get involved, as they should have done, and work on developments needed by the industry and their introduction.

Judging by what happened, no active steps were taken on propagandizing the tools and the development of substantiated recommendations for their use by the VNIInstrument, the "Orgpriminstrument" and the main technological institutes of the metalworking sectors. This is the cause of today's picture. It has come to the point where the "Instrument" Plant, in order to sell its product, ties it in the form of a compulsory "load" to other customary articles.

By multiple purchase orders, the innovations last year were distributed at enterprises of its own sector -- which and how many they must receive. They decided to supply them in a set with machine tools with NC, although the equipment parameters did not change essentially.

The new year did bring palpable changes. The thing went around a closed circuit as before: the Minstankoprom avoids the issue, the USSR Gosplan is planning, the USSR Gosstab is distributing, the customers refuse the tools and the plant continues to manufacture more of them. They succeeded recently on selling partially, 581,000 rubles worth, of tools made the previous year. They were shipped on orders of the first half year, and to some customer -- for the entire year. But what to do with the remainder 202,000 worth of rubles, nobody knows. The forecast by production people is not good: taking into account the planned output, the mountain of unsold tools will grow.

"If necessary, we can renew the present volume of production of tools from super-hard materials," stated B. Grokhol'skiy, director of the enterprise. "Meanwhile, in exchange, we could manufacture cheaper tools from high-speed steel or oxide metal ceramics more in demand by machine tool operators today... But we have no right to rearrange production.

Why? The ministry finds it advantageous to produce highly expensive products, even though they are not in great demand. Otherwise, how else to cover 7,000,000 rubles of the plan for the "Instrument" Plant alone?

Proper credit should be given to the Minstankoprom management. They attempt to break the circle by evaluating the situation critically.

"At present, an order was prepared that obligates all plans in the sector to include the introduction of tools from super-hard materials in plans and report on results," stated I. Ordinartsev, deputy minister. "We are organizing propaganda and are thinking about expanding the assortment. The progress will, of course, show up mainly in our sector. If the USSR State Committee on Science and technology, whose word is the most authoritative in such cases, will support us and obligate all departments to specify the introduction of the progressive tools in plans of metalworking enterprises, the situation will change decisively."

A similar opinion was also stated by N. Panichev, first deputy minister.

Both are experienced managers. Comparatively recently, they themselves managed large plants. Therefore, they know how difficult it is to overcome inertia and a conservative attitude towards the new. In some cases, the most reliable means is a directive order. Possibly, it will determine precisely the further fate and area of application of super-hard materials.

Meantime, the plant workers are asking how long they will continue to do not very useful work? They, in fact, come to the shops to produce products needed by the national economy and not to increase the reserves of expensive unnecessary tools.

2291

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## METAL-CUTTING AND METAL-FORMING MACHINE TOOLS

### NEW NC MACHINES RAISE PRODUCTIVITY AT ODESSA PLANT

Kiev RABOCHAYA GAZETA in Russian 14 Mar 84 p 1

[Article by RABOCHAYA GAZETA reporter team, I. Ryabokon', machine-tool building production association team leader; I. Travenko, control foreman at construction finishing machines plant; N. Chechin, chief mechanic of Maslozhirprom production association; and V. Kreshchuk, correspondent (Odessa), under the heading "Machine Building: Equipment Payoff": "Machine Tool in a Case"]

[Text] The trade mark of the Odessa Machine Tool Building Production Association, which manufactures precision boring, honing, and other special high-precision machines, is well-known at many industrial enterprises of the country and abroad. Workers of the association proudly told us that their machines are operating successfully at the Volzhskiy Automobile Plant, the Kama Automobile Plant, the Minsk Motor Plant, and the Rostsel'mash farm machinery plant. Not long ago the first automatic transfer line was built. It is designed for finishing treatment of cylinder blocks for Niva, Kolos and Don-1200 harvester combines, on the precision of which engine efficiency depends. Formerly such operations were performed manually or with imported equipment.

"Machining precision on Odessa machine tools is double that of similar machines of the English firm Ekstsello," remarked Yu. V. Svinarev, assistant shop superintendent at the Kursk Tractor Spares Plant, speaking for the customers.

As is known, one of the key tasks of the 11th 5-Year Plan is the fullest and most effective utilization of fixed assets. So during our assignment we strove to determine what some Odessa enterprises are doing to improve the machine shift coefficient.

Unfortunately, in the machine-tool building association it is still rather low: only 1.35. For several years now the personnel have been working in conditions of reconstruction, shops are being expended, renovated and retooled, and working conditions are improving. One hundred and two numerical control machine tools, six of them machining centers, have been installed. In Shop No. 4, four numerical control lathes equipped with arms for handling workpieces have been set up in a separate group operated by one person. The introduction of state-of-the-art equipment and better production processes requires, in the first place, a strict inventory of all production facilities. However, only this year has the association begun an evaluation of work stations.

The total number of machine tools in the basic production sequence remains the same as at the beginning of the 5-year plan. But since no one is in a hurry to dismantle and sell off unneeded equipment, quite a few of the work stations in the shops are operating at only one-third capacity or even less.

The people at the construction finishing machines plant also failed to carry out the necessary calculations that would ensure the efficient operation of new machinery. As a consequence the equipment workload ratio and machine shift coefficient for numerical control machine tools are much lower than for universal machines. They are used to machine only structurally simple parts.

In the No. 2 mechanical assembly shop it was a pleasure to watch turner Aleksandr Bashtovoy operating three single-spindle automatic lathes alone, while his colleague, Leonid Sobolev, operates two six-spindle semi-automatic machine tools. However, when we spoke to them we found out that the machine tools assigned to them operate only one shift.

There is much idling equipment at the Promsvyaz' Pilot Plant, where the machine workload is highly uneven from one shift to another. Not long ago two transfer lines were installed there. One of them is for pattern application to circuit boards, the other is for developing it. With the help of mechanical arms it would be possible to merge the two lines in a unified cycle, which would free six work stations. However, the operational rhythm of the lines keeps breaking down because the supplier plant in Kishinev is delivering material of varying thickness for the circuit boards.

In an effort to keep abreast of the others, the Legmash light industry machinery plant last summer acquired an automatic lathe costing some 40,000 rubles. However, it is still in its factory applied protective grease and case because the necessary fixtures and set of tools have not arrived, and besides, no one has been trained to operate it. Nikolay Polishchuk, senior foreman of the mechanical assembly shop, sees no great need for the new machine because the equipment workload ratio and machine shift coefficient of metal-cutting machine tools of the main production facility are equal to 0.72 and 1.09, respectively. In answer to the question how many people would report that day for work in the second shift he said,

"Probably none."

At neither the Promsvyaz' nor at the Legmash plant did we find log books for registering equipment downtime. Yet downtime is due not only to low work loads, but also to worker absenteeism. The absence of basic records prevents gaining a clear idea of the causes of underutilization of machine tools.

Like most Odessa plants, the enterprises visited by the newspaper team operate in cramped conditions. A major reduction in the total number of work stations would make it possible not only to provide full work loads for operating machines and improve their shift coefficient but also to increase available space. There would be greater opportunities for improving working conditions and production standards and raising the level of mechanization of loading-



unloading operations. Fewer people would be engaged in heavy manual labor, and workers could be retrained to operate machine tools.

The resolution of the CPSU Central Committee and the USSR Council of Ministers on the further improvement of the economic mechanism stresses the need to raise the level of production cooperation. So far enterprises in the region seek to acquire their own primitive facilities: each one operates a little foundry of its own, a little forge shop of its own... As a consequence some have highly efficient program controlled machine tools and powerful presses operating only one shift while their neighbors are wasting time and money doing the same things with obsolete equipment.

Obviously, the local authorities must get more actively involved in this. Incidentally, Odessa already has some good experience of cooperation between work collectives which mastered the production of parts for pelletizers at the port plant. Why not make full use of it?

9681

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## METAL-CUTTING AND METAL-FORMING MACHINE TOOLS

### MODERNIZATION, AUTOMATION OF KIROV PLANT REVIEWED

Moscow EKONOMICHESKAYA GAZETA in Russian No 10, Mar 84 p 6

[Article by Nikolay Nikolayevich Kostikov, general director of the Minsk Machine Tool Building Production Association imeni S. M. Kirov, "Along the Path of Technical Progress"]

[Text] The collective of the Minsk Production Association imeni S. M. Kirov completed successfully the plan for three years of the five-year plan in January of this year. At present, all series produced machine tools are certified for the State Emblem of Quality. Nikolay Nikolayevich Kostikov, general director, talks about raising the technical standard of production. N. N. Kostikov began 20 years ago as a mechanic's apprentice at the Minsk Automatic Lines Plant. While working, he studied at the vuz; also, became a foreman, a senior foreman and a deputy chief of the shop. In 1972, he was appointed shop chief of the Minsk Machine Tool Building Plant imeni S. M. Kirov. He worked as deputy director and chief engineer, and since 1980, as the general director of the association.

For several years already, our collective has been working under the slogan "In union of science and production -- to each product high quality of development and manufacture." What does this mean?

#### New Series of Machine Tools

A long-range comprehensive plan for the technical, economic and social development for the 11th Five-Year Plan and the period for 1990 was developed and is being implemented in the association. According to it, a new series of broaching machine tools, including models with higher speeds is being mastered. Each one will be able to replace two-three machine tools manufactured at present.

It is planned to increase the output of automatic machine tools to 65 percent. They are equipped with manipulators, standardized and typical materials handling devices, rotary and hinged tables. All this produced conditions for developing multimachine tool servicing.

At present, the special design bureau is developing a new method for manufacturing the broaching tool from bimetallic intermediate products, obtained by the explosion welding method. The durability of such tools is two-three times greater than that of the usual tools and steel consumption is reduced up to 80 percent.

Among the innovations is a vertical broaching machine tool with a tool magazine and an automatic manipulator to set and remove parts. Machine tools with NC and continuous action automatic machine tools were developed. Special high precision equipment was designed to manufacture individual kinds of parts (internal combustion engine cylinder blocks, bushings, turbine blades).

An important detail is that the unit power capacity of the new series of machine tools was reduced by 20 percent on the average.

Creative cooperation between our workers and specialists and scientists strengthens every year.

Jointly with the Electric Welding Institute imeni Ye. O. Paton, a process was introduced for electroslog rewelding of the cutting tools for reuse in production. This made it possible to save up to seven tons of high-alloy steel annually. Specialists of the Moscow VNIITmash [All-Union Scientific Research Institute of Machinebuilding Casting, Casting Technology and Automatic Casting Production] jointly with the department of the chief metallurgist of our main plant, introduced a process of gas-powder hard facing to correct flaws in cast iron castings.

Good creative relationships with scientific establishments of the country make it possible for the association to increase the rate of machine tool production from year to year, and reduce the costs of their manufacture and alignment. The introduction of a new series of broaching machine tools (with their annual production starting in the last year of the 11th Five-Year Plan) will make it possible for us to save the labor of about 300 machine operators and free 1500 square meters of production areas. Due to their use, the total annual saving to the national economy will exceed 33 million rubles.

#### According to Target Programs

The collective of our association persistently follows the course of intensifying production. In three years of the five-year plan period, dozens of machine tools were produced above the plan and about two million rubles of profit were obtained above the plan. Over 90 percent of the increase in the output was due to the higher productivity of labor. Every year our contract obligations to customers are met in full.

A large amount of work is being done on introducing new equipment and progressive technology; mechanizing and automating production, reducing manual labor and strengthening the saving mode.

In each of these leading directions, there is a comprehensive target program in the association. Thus, according to one of them four manipulators and two robot equipment groups were introduced in the basic production shops to load and unload parts when broaching and gaging gears. Mechanized stands are introduced in the assembly shop for labor-intensive operations.

A conveyor is in operation for the assembly of the mechanism of the cutting machine tool for feeding material. A lumber sawing section in the painting-packing shop has mechanized materials handling and waste removal. By the end of the five-year plan period, 30 robots, manipulators and robot equipment will be in operation.

A special program is targeted to reduce the labor-intensiveness of products. Two years ago, machine tool builders came out with an initiative to increase production volume in the 11th Five-Year Plan period without increasing the consumption of rolled stock and fuel energy resources. The initiative was approved by the Belorussian Communist Party Central Committee.

As is well known, saving begins with the project. Here, in the designs of broaching machine tools of the new series, over 100 kilograms of metal are saved per tool. The weight of each machine tool for machining bushings was reduced considerably.

This was achieved by the wider use of efficient shapes of rolled stock, as well as of intermediate products obtained by continuous and centrifugal-chill mold casting. According to specialists, this will save in the five-year plan period 3000 tons of metal and increase the coefficient of its utilization considerably.

Large measures are being implemented on saving fuel-power resources. Changing the electric machine drives to semiconductor drives on planer, milling and milling-boring machine tools alone made it possible to save over half a million kilowatt-hours of electrical power. This was done according to a proposal of engineers P. Shpilevskiy and A. Kurlenko.

A special program envisages a sharp reduction in manual labor; and the mechanization and automation of heavy and labor-intensive processes. Its implementation will make it possible to raise the level of mechanization and automation by the end of the five-year plan period in basic production to 85 percent, and in auxiliary production to 75 percent. The number of workers doing manual labor will decrease by 20 percent.

#### Activity of the Labor Collective

I usually begin the working day by visiting shops. By spending time at work positions, speaking to workers and specialists, one receives a new charge of energy.

Today, for example, I spent more time near the work position of A. Makeychik, grinder in the 10th mechanical shop. He is one of our best innovators, an active efficiency expert and a teacher of young people. A high sense of duty, care for his comrades, ability to fire up people to do glorious things inspired respect for Anatoliy Nikolayevich not only in the brigade and shop, but also in the association. For selfless labor, A. Makeychik was awarded orders of Labor Glory grades II and III and honorable badges. Rightfully, the machine tool builders were unanimous in naming Anatoliy Nikolayevich a candidate deputy to the USSR Supreme Soviet.

One gets great satisfaction in communicating with Vladimir Petrovich Polyachenko, brigade leader of assembly mechanics and member of the party committee of the plant. His brigade works ahead of schedule. One always learns much of interest from talks with Yuriy Platonovich Teteruk, Communist, brigade leader of milling machine operators and chairman of the plant brigade leaders council. Members of his brigade came forward with the initiative to fulfill the plan tasks for the four years of the five-year plan by 3 July, the day of the Fortieth Anniversary of the Freeing of Belorussia from the German fascist invaders. This initiative was taken up by other brigades of enterprises in the Belorussian capital.

Raising the creative activity of the collective is facilitated by socialist competition in which practically all workers and specialists participate. Using computers to prepare summaries made it possible for managers of subdivisions, party and trade union organizations to give great attention to the creative side of the matter, expand the range of the labor competition, increase its organizing and training effects, and pull the lagging ones up to the level of the leaders. The improvement of the organizational forms of socialist competition is done sequentially.

We, however, are not satisfied with the achieved results and do not think that all problems have been solved. We still have many difficulties and shortcomings. Take, for example, the important value of modernizing the main plant. It was unjustifiably delayed. This is a serious brake on the road to increasing the output of new machine tools.

Violations of labor and production discipline, scrap, unproductive losses and the irresponsible attitudes of some managers toward their entrusted work have not been overcome. The brigade form of organization and labor incentive require further improvement.

The party, trade union and Komsomol organizations and the board of the association are working on the elimination of these and a number of other shortcomings.

The Kirov workers adopted a counterplan for the fourth year of the five-year plan. It was decided to raise labor productivity by 1.2 percent above the plan (4.1 percent), and reduce production costs by 0.6 percent. In 1984, the entire increase in the volume of production will be obtained by increasing the productivity of labor. The quality of products will be raised and scrap



losses will be reduced. Results for January-February indicate that the schedule for the counterplan is being observed precisely.

The plan for raising the productivity of labor was fulfilled by 101.3 percent, and for the volume of production by 100.8 percent. In two months, products to an amount of almost 200,000 rubles were produced above the plan.

Today, the main concern of our collective is the most rapid development and mastering of the production of new highly productive equipment, raising its technical standard and competitiveness, improving the efficiency of production and the quality of work.

2291

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## METAL-CUTTING AND METAL-FORMING MACHINE TOOLS

### MODERNIZATION OF ODESSA MACHINE TOOL BUILDING ENTERPRISES

Moscow EKONOMICHESKAYA GAZETA in Russian No 7, Feb 84 p 8

[Article by Konstantin Mikhaylovich Manenkov, general director of the Odessa Machine Tool Production Association, "Effect of the Economic Method"]

[Text] The Odessa Machine Tool Building Association is one of the leading enterprises in the sector. By reequipping, high rates of increasing the output and raising the product quality were achieved. K. M. Manenkov talks about ways to intensify production. After graduating from the Odessa Polytechnical Institute in 1957, K. M. Manenkov worked as a designer, deputy chief of the Technical Administration of the Soviet of the National Economy, chief engineer and director of the Avtogenmash Plant and, since 1975, as director of the Radial-Drilling Machine Tool Plant imeni V. I. Lenin, and since 1976 as general director of the association.

The problem of our collective is to provide to the national economy machine tools with a drilling diameter of from 50 to 70 millimeters, and deep drilling machine tools. Our diamond-boring automatic and semiautomatic machines are a considerable share of the output of the total volume of machine tool building.

In reply to the decrees of the December (1983) Plenum of CPSU Central Committee, following the example of the best enterprises in the sector and in the republic, a competition was developed in the association to raise the productivity of labor by 1.5 percent above the plan (the task for the year was 7.5 percent) and reducing additionally the production cost of products by 0.6 percent (as against 7.8 percent per plan). We are orienting ourselves in this on an accelerated introduction of achievements of science and technology.

The following equipment is already operating in the shops: seven processing centers, four robot equipment complexes and 81 machine tools with numerical control. There will be one-and-a-half more such machine tools by the end of the five-year plan period. In 1984 alone, the association plans to acquire equipment in the amount of two million rubles.

## "Modernization" Scientific Production Association

We improve technical production within the framework of shop modernization. The stress is put on cost accounting. In the course of modernization, the repair-construction section was transformed into a construction installation administration which became one of the basic subdivisions of the association. An important decision was to organize on social bases a "Modernization" Scientific Production Association. Besides specialists of the main enterprise, the Radial-Drilling Machine Tool Plant, it contained the Odessa Engineering-Construction Institute and the "Ukrgipromash" Design Institute.

The joint efforts of production engineers and the scientific-planning ideas of designers and developers of new equipment produced positive results. In particular, optimal versions were found for arranging the shops.

It was necessary to produce a flexible production facility capable of satisfying efficiently the increasing demands of industry for rapidly adjustable sets of equipment. The plan approved by the ministry envisaged the organization of automatic line sections controlled by computers for finish machining of parts, with the lines being equipped with transportation and measurement devices and NC systems. At the same time, progressive technology processes were being developed.

The communists of the association came forward with an initiative, supported by the entire collective, to carry out modernization intensively without interrupting existing production. The final goal was formulated like this: "Master the output of new machine tools in new shops; on new equipment, with new technology."

Economic calculations indicated that with modernization, unit capital investments per 1000 rubles of increase in production are 40 percent lower, while the output-capital ratio is 1.5 times greater as compared to building a new plant. The labor of 2000 people and about 12 million rubles of capital investments will be saved. The main thing -- by the moment of starting-up the shops being modernized, we will develop new in principle machine tools that will make it possible to use modern electronics.

The basic load of the labor-intensive work on producing the new equipment was undertaken by the engineering services, especially the collective of the diamond-boring and radial drilling machine tools. It is the second largest organization in our association. Close cooperation among designers, engineers and managers of the machine shops helped shorten the time of the design work.

Creative cooperative brigades on the "shop-department" principle appeared on the initiative of the party committee. Scientists of 18 institutes of the country participated actively with the brigades in developing documentation, manufacturing and debugging equipment prototypes and introducing progressive technological processes.

## Single Rhythm of Work

We decided to start with the foundry shop, whose quarters, equipment and technological processes were obsolete. The shop collective was stable with a strong party organization. As suggested by A. Borodin, party organizer and foreman of the trimming section, a special brigade was formed to help our builders and installers. It not only did auxiliary work but also tasks that required a certain amount of skill. This was acquired by these workers by taking courses.

The construction repair administration organized its work so as not to interrupt the technological cycle of foundry production. As a result, seven-ton and three-ton cupolas were placed in operation ahead of schedule.

Experience acquired in modernizing the foundry was utilized in rebuilding the pattern and machine shops. The erection of the main building for flow-line production of radial-drilling machine tools with a total area of over 17,000 square meters required special intense regularity of construction.

The "moving" schedule was observed very strictly: some sections and brigades continued to work in the old quarters, subject to being torn down, while others moved to new buildings. People in both places worked on basic products.

Labor records of builders and production workers became routine. For example, A. Malinoskiy's mason brigade erected, with the help of machine tool builders, 800 square meters of internal partitions. The brigade of I. Senkevich built the frames of two bays with an area of 7500 square meters in 47 days, reducing the norm schedules considerably.

The construction-installation administration has already fulfilled a volume of over 10 million rubles and modernized and rebuilt 30,000 square meters of production areas.

During modernization, 60 machine tools with NC were introduced. Before the end of the five-year plan period, we intend to put into operation 75 more such machine tools. Over 100 of automatic and semiautomatic machines will also be installed. A special laboratory is involved in the efficient loading of the new equipment. This laboratory has a friendly collective of electronic engineers, designers, mathematicians and adjusting engineers. At present, literally, only minutes and hours are required to develop the manufacturing technology of parts and programs for their machining on machine tools with NC, rather than days and weeks.

A casting conveyor and a mechanized warehouse of finished parts were built, work positions were rearranged and many other innovations were introduced, according to the NOT [Scientific organization of labor]. The improvements introduced in the technology and organization of producing special machine tools made it possible to reduce the labor-intensiveness of their manufacture by 2500 norm-hours and reduce the entire cycle, from design to testing and tune-up, to four-tenths of the previous time.

Specialists of the association are preparing for the production of automatic "machine tool plus robot" sets. By the end of this five-year plan period, new models will be developed of drilling-milling-boring machine tools with NC, a tool magazine and an automatic tool change. We are also getting ready for the production of readjustable sets of finishing-boring machine tools.

#### For the Honor of the Brand

The development of technology in machine tool building requires that modernization become a continuous process. Obviously, it is difficult for the collectives to do this without violating the regularity of the basic production. Nevertheless, we are constantly forced to find new ways to reach advanced boundaries in machine tool building.

In 1980, the capacities of the association made it possible to produce products in the amount of 20 million rubles. In 1981, the total volume of production exceeded 33 million rubles. The plan for 1983 specified an output of 40,800,000 rubles. The collective overfulfilled this task.

Thus, in only three years, machine tool output increased from 28,500,000 rubles to 41,000,000 rubles. The matter is not only in quantitative indicators, but also in growth of production profitability and higher quality of the products. Today, all basic machine tools and modifications of the diamond-boring heads are marked with the state Emblem of Quality.

With a large stockpile of semifinished products, the collective of the association is starting 1984 with confidence. January tasks have been fulfilled for practically all basic technical-economic indicators. Sixteen machine tools above the plan were shipped to customers, the task on the productivity of labor was exceeded by 104.6 percent and production costs were reduced.

Complicated problems must be solved in the very near future. It is still necessary to build up to 35,000 square meters of production areas, master new capacities, build housing for about 5000 people with all the necessary cultural-personal service establishments. In solving the housing problem, we count on the help of local Soviet organs.

In the future, it will be necessary to increase the volume of production to 120,000,000-150,000,000 rubles per year. The problem is complicated, but can be solved by an experienced collective. However, there are obstacles with which we alone will find it difficult to cope with. We are modernizing and building practically with our own forces. The construction-installation administration could do a considerably greater amount of work and thereby accelerate the putting of new capacities in operation, but regrettably, it is planned to allot limited resources for this purpose, which will slow down the achievement of the set goals.

Time does not wait. It is necessary to facilitate the acceleration of technical progress in machine tool building by all means and with all forces.

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SELF-LOADING, FOUR-SPINDLE TURNING CENTER DESCRIBED

Kiev TEKHNLOGIYA I ORGANIZATSIYA PROIZVODSTVA in Russian No 1, Jan 84 pp 31-33

[Article by engineers L. S. Pereverzev, A. V. Kobyl'ko, and O. I. Meshkov:  
"Mechanization of the Process of Machining Rollers for Belt Conveyers"]

[Text] At most machine-building plants rollers for belt conveyers are machined on engine lathes, with 70 percent of the time devoted to auxiliary operations: mounting, truing, chucking, and removing the workpiece; moreover, as a rule the required surface finish and precision are not obtained.

The model AM 10574-AM10577 four-spindle standard-unit machines were developed with the purpose of mechanizing the process. On these machines, two passes (rough and finish) can be performed during one mounting of the workpiece to perform two-way boring, end cutting, and chamfering of tubular rollers for belt conveyers, 102, 127, 159, and 194 mm in diameter, and 160 to 1,800 mm long.

The machines can operate in two modes, semi-automatic or manual.

In the initial position a pipe 6 is mounted in pneumatic stops 8 and clamped in self-centering vices with an electrical drive 4 (see figure).

When the pipe is clamped the keys automatically retreat to the initial upper position. A rotation of the drum 5 sets the machined pipe 6 in the operating position. Locking of the drum occurs after a rotation through 90 degrees. Simultaneously, the boring heads 2 move with acceleration along the guideways of the power tables until their operational displacement begins simultaneously with the rotation of spindles 9 and 7.

Initial machining of the hole--end cutting and external chamfering--is performed by tool units 3 mounted on the lower spindles 9; this is followed by automatic withdrawal of the boring heads 2, rotation of the drum 5, and locking of the pipe in the upper position. In this position the boring heads 2 move in for the final finishing of the holes, the upper spindles 7 begin operating, and the machined pipe 6 returns to the initial (loading-unloading) position. When a new blank is loaded the machining cycle is repeated.

The motion of the boring heads is regulated by contactless end switches 10; readjustment for pipe diameter is done by replacement of the keys 12 of the self-centering vices 11.

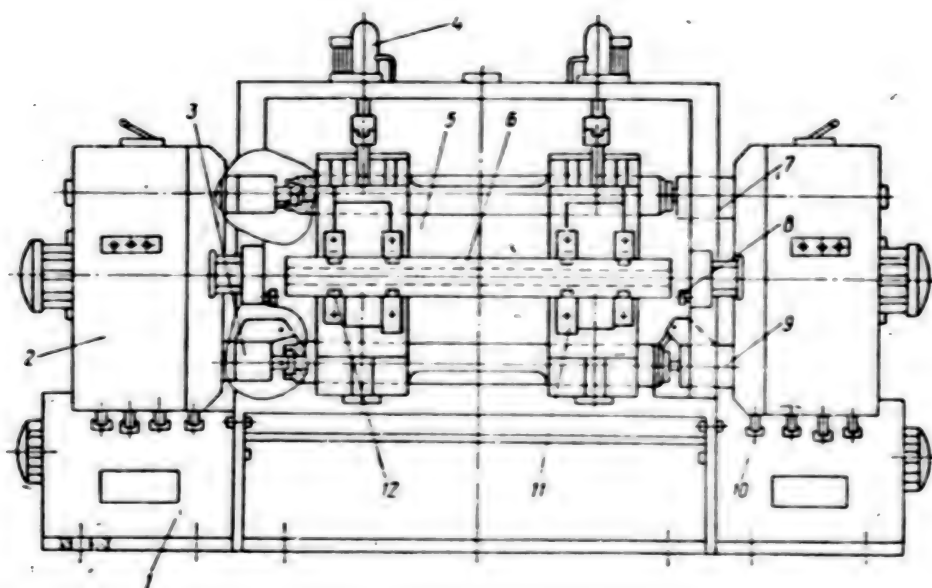


Diagram of Four-Spindle Standard-Unit Machine for Double-End Pipe Boring

Operations requiring manual labor on the standard-unit machines include mounting and removing the workpiece. They can be mechanized with the help of a type ShBM-150 articulated balance arm or suitable models of industrial robots.

Introduction of four-spindle standard-unit machines for double-end boring of tubular rollers for belt conveyers has made it possible to reduce the labor intensiveness of machining to two-fifths to one-quarter of that required when machining on universal machines, conditionally release eight machine operators, and thereby effect a saving of 50,000 rubles.

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9681

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## OTHER METALWORKING EQUIPMENT

### NEW PLASMA CUTTER DEVELOPED AT RYAZAN PLANT

Moscow TRUD in Russian 18 Dec 83 p 1

[Article by engineer Yu. Kazarin under the heading "Report from the Front Lines": "Cutter and Plasma: Unique Machine for Processing High-Strength Steel Developed in Ryazan"]

[Text] It is not easy to manufacture a large part out of especially high-temperature steel alloy, which is extremely hard. Machining the blank then becomes a problem in itself. It is done slowly, at low speed. And by the time the part is finished, the box with the expensive hard-alloy cutters is empty: all have been worn down.

Ryazan machine tool manufacturers and scientists have developed a machine tool which can handle the very hardest high-temperature alloys. And it can be operated at maximum productivity, without fear of using the very highest speeds.

From the outside, the machine differs little from other special machines produced by the Ryazan Machinebuilding Association. The only difference is that several plasmotrons, unusual for lathes, have been installed alongside the cutter. This unit was developed at the Arc Welding Institute imeni Paton of the UkSSR Academy of Sciences. The blanks are processed using plasma. The plasma flame, at up to 30,000°, momentarily softens the surface layer just in front of the cutter, which then removes the metal.

This new invention is also advantageous in that this surface layer of metal, consisting of expensive high-alloy materials, does not burn up in the plasma. The shavings are resmelted.

However, it did not come fully perfect from the developers. A number of problems had to be solved. The operator had to be protected from the light generated when the plasmatron is on and from the heavy metal aerosols, ozone, nitrous oxide and other airborne hazards. Scientists from the Hygiene Institute imeni Erisman took on this problem and succeeded in completely covering the machine, so all the mechanisms are remote-controlled. It is even possible to switch on an industrial tenevision system and observe all the machining processes on a screen far away.

"Every detail was considered when developing the machine," says Ye. Kuznetsov, its chief designer. "Take the problem of shavings. The composition of the alloy

and the temperature at which it is being cut led to a situation in which a huge steel "snake" coiled down and ensnared the whole machine. We weren't able to crush it using ordinary methods, because the material is so ductile. This problem was solved by scientists at the Georgian Polytechnical Institute imeni Lenin. An original device breaks the "snake" up into small pieces which can be easily transported for resmelting and which do not hamper operation of the machine. Operators have to wear protective ear muffs when operating plasmatrons, but here, the noise isn't any louder at all than near an ordinary metalcutting machine tool. We use special noise suppressors developed especially for this brainchild of ours.

This innovation, a first for domestic industry, permits a five- to six-fold increase in labor productivity when machining especially high-temperature alloys. Large quantities of expensive cutting tools are saved. The impact of introducing just one such machine exceeds 260,000 rubles. The state commission gave this unit a high appraisal when accepting it. The first unit has already been shipped, to the Dneprospetsstal Plant in Zaporozhye.

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CSO: 1823/161

## BERDYANSK PLANT INSTALLS AUTOMATED SHEARING LINE

Moscow STROITEL'NYYE I DOROZNYYE MASHINY in Russian No 2, Feb 84 pp 21-22

[Article by engineers A. L. Kolyutin and A. P. Smagach (All-Union Design and Technology Institute for Road Building Machinery) in the "Production Technology" section: "An Automated Sheet Shearing Line"]

[Text] The blank preparation sections and shops of most plants of the industry are equipped with guillotine shears for cutting sheet metal. Shearing accounts for up to 25 percent of the total labor intensity of blank preparation operations, with most of the time going into the auxiliary operations of picking up and transporting the sheets, feeding them to the operating area of the guillotine shears, holding the blanks during shearing, and removing the blanks and scrap from the shears. These operations are hazardous and require considerable physical effort. Delays are frequent due to the need to wait for gantry cranes to transfer sheets from packets to the shears feeding area.

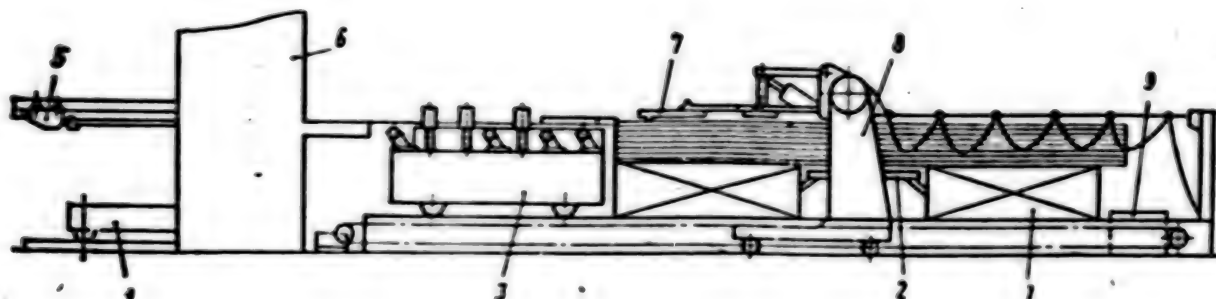
The Berdyansk Road Machinery Plant, in collaboration with the All-Union Design and Technology Institute for Road Building Machinery, has developed and introduced into production an automated sheet shearing line on the basis of the N478A guillotine shears. Designed for rectangular gauge as well as oblique mark-out shearing, it comprises a complex of mechanisms and devices (see figure) providing for feeding sheets directly from packets to the operation area, aligning and supporting the sheets during shearing, automatically producing the required dimensions, removing and stacking blanks, and transferring them from under the shears frame to within reach of the hoisting-and-conveying machinery.

## Specifications

## Sheet dimensions, mm:

Length	up to 7,000
Width	up to 2,000
Thickness	5-20
Maximum weight of packet of sheets, tons	20
Rate of feed of sheet, m/sec	0.01-0.5
Length of gauge sheared blanks, mm	105-2,800
Installed capacity (without shears), kw	30
Dimensions of line, mm	19,200X5,800X3,100





Automated Sheet Shearing Line

1. Lifting table; 2. Bridge; 3. Moving feeder table; 4. Removal truck; 5. Shear gauge with support; 6. Guillotine shears; 7. Pusher; 8. Manipulator; 9. Manipulator drive.

The lifting tables (there are two) are for lifting the packet of sheets to the pickup height of the manipulator; each table consists of a base and platform joined by a lever system, as well as two hydraulic cylinders the piston rods of which are connected by levers.

The feeder table is for supporting, centering and guiding the sheet fed to the shears; it consists of a frame, which moves on rollers along a track, horizontal supporting rollers, and a guide device which includes two side beams (one of them spring-loaded) on which are mounted vertical base rollers. The guide unit is adjusted to the width of the sheets by means of a drive which assures synchronized movement of the beams with the rollers. Also mounted on the feed table is a centering device consisting of a pair of levers with rollers and hydraulic cylinders for actuating the levers.

The manipulator is for detaching the upper sheet from the packet and transporting it to the shearing area; it consists of a gantry which travels on rollers along a track, and a frame on which are mounted loading electromagnets and stops. The frame is connected with the gantry by levers and a hydraulic lift cylinder. Mounted on the manipulator is a pusher for moving the sheet remnants and discarding scrap from the shearing table. The manipulator drive has draw chains connected with the gantry and a drive and tensioning device. The drive consists of a DC reversing motor with a thyristor converter, V-belt transmission, electromagnetic clutch, and reduction gear on the shaft of which is mounted a safety sprocket with shear pins. The torque is transmitted via a chain drive to an intermediate shaft, and through rubber-bushed studs couplings to the end shafts, on which are mounted the driving sprockets of the drive chains.

The truck is for transporting blanks and scrap from under the shears; it consists of a platform mounted on rollers on which it travels along a track with the help of a traction chain.

The gauge and support is designed to control the manipulator drive and shears, and to support the sheared edge of the sheet when it is moved up to the gauge; it consists of a single rail mounted on the shear beam, a carriage with a supporting lever which travels along the rail, and a stop connected with the end switch.

When cutting sheets into gauged rectangular blanks the feed table is set in the position closest to the shears, while its base rollers are extended to the dimension corresponding to the width of the sheets. The stop of the support is set at a distance from the shears equal to the length of the cut blanks. The packet of sheet metal is placed on the lifting tables, which are raised to a height at which the lower edge of the top sheet is slightly above the supporting rollers of the feed table. Then the manipulator is positioned so that its stops are located immediately behind the packet; the frame is lowered and the sheet is picked up by the electromagnets. After that the manipulator drive is switched on to feed the sheet in the direction of the shears, with the position of the sheet adjusted with respect to the base rollers of the feed table. As the sheet moves forward it settles on the horizontal supporting rollers, while the side edges come in contact with the base rollers. Deviations from lateral dimensions and displacements caused by skewness of the sheet are compensated by lateral displacements of the spring-loaded side beam. As the edge of the sheet protrudes beyond the shearing plane it interacts with the support carriage, moving it up to the gauge, after which the end switch stops the manipulator and switches on the shears. The sheared blank falls into the removal truck; with the load removed the carriage rolls down the rail to its initial position, and the manipulator drive switches on to return to the pick-up position. When cutting oblique shapes or other patterns the feed table is set at the necessary distance from the shears and its base rollers are shifted to horizontal position. The stack of blanks is placed on one of the hydraulic lifting tables. The top blank is picked up by the manipulator, transferred and laid on the supporting rollers of the feed table, along which it is directed as required to the shears. After shearing the finished part is picked up by the manipulator and transferred to the second lifting table, while the scrap falls into the removal truck.

The line is operated from a control panel.

Annual savings resulting from the introduction of the automated sheet shearing line exceeded 25,000 rubles.

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## OTHER METALWORKING EQUIPMENT

### BRIEFS

**NEW PRESS -- DNEPROPETROVSK --** A 6,300 ton press built in the Dnepropetrovsk Heavy Press Plant combines force and precision. Its tests have been completed. Such a press is capable of handling intermediate products weighing up to 160 tons and forge parts hard to deform and special kinds of steel. This equipment is intended for forging in the Chelyabinsk Metallurgical Combine. [Text] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 17 Mar 84 p 2] 2291

**MULTI-SPINDLE LATHES -- Kiev --** Products of the Automatic Machine Plant imeni M. Gor'kiy are widely known in our country and abroad. Customers are attracted to the Kiev machine tools by reliability, high productivity and long life. These features made it possible for the plant collective to have the Emblem of quality awarded to about 70 percent of their output. Designers made a great contribution to this success. Recently, a conference was held at the plant on problems of the long-range development of multi-spindle automatic machines. Representatives of customers were invited. A questionnaire was sent out earlier. The analysis of the replies gave designers rich food for thought. At present, in developing prototypes of new multi-spindle automatic machines, the designers will take into account the questions and desires of the customers. [By L. Samoylenko] [Text] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 21 Mar 84 p 2] 2291

**CHEMICAL ETCHING -- Gorkiy --** Scientists of the Gor'kiy Polytechnical Institute developed a progressive method for chemical etching of metals that makes it possible to raise the quality of the processed products considerably. The installation for the etching board for electronic devices operates at twice the speed of a similar series equipment. Due to the constant speed, the process quality is stabilized and the etching proceeds with an accuracy of up to hundredths of a micrometer. [Text] [Moscow SEL'SKAYA ZHIZN' in Russian 16 Mar 84 p 1] 2291

**PLASMA CUTTER --** Red hot plasma jets heat the metal surface and the cutter removes the metal from the intermediate product layer by layer. Thus, operates a planer machine tool combined with plasma machining, released for experimental operation to the Leningrad "Izhorskiy zavod" Association. The progressive metal-cutting technology using plasma guns is used more and more at "Izhorsk." It insures a high economic effect. The use of plasma in lathe machining of large

size ingots, for example, reduces the operation time to a half or a third, reduces the consumption of cutting tools to a fifth or a sixth and of electric power to a half. An increase in the productivity of labor is noted especially when machining parts made of corrosion-resistant, refractory steels and alloys with high mechanical properties. The decrees of the December (1983) Plenum of the CPSU Central Committee call for the accelerated introduction into practice of the achievements of scientific technological progress that would insure all around saving of labor and material resources. A number of turning machine tools of various models, planers and turret-type machine tools are already equipped with plasma guns. This work is done by a special group for introducing combination plasma-mechanical machining, developed at the enterprise. The group implements scientific research and experimental design work on designing and manufacturing new types of machine tools jointly with specialists of the All-Union Scientific Research Planning Design and Technological Institute of Electric Welding Equipment, the Central Scientific Research Institute of Machinebuilding Technology, the Leningrad "Elektrik" Plant and other enterprises and organizations. [Text] [Leningrad LENINGRADSKAYA PRAVDA in Russian 16 Feb 84 p 1] 2291

PRECISION GRINDER -- Leningrad -- The Leningrad machine builders, as is well known, mastered the production of machine tools on which it is possible to manufacture miniature parts with tolerances of several tenths of a micrometer. This year alone, the Plant imeni Il'ich supplied to machinebuilders and instrument building enterprises models of hundreds of precise rapidly readjustable machine tools. Among them, profile-grinding machine tools for machining intermediate products which are almost impossible to see with a naked eye. For this reason, this equipment is supplied with a microscope. Recently, the Il'ich workers completed and released to the customers the first lot of a new series of equipment designed to manufacture superprecise parts for fuel apparatus. These special design machine tools were assembled by leading brigades of V. Rodionov and V. Trummel' [By V. Alyushinskiy] [Text] [Moscow IZVESTIYA in Russian 9 Dec 83 p 1] 2291

CSO: 1823/179

## AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

### SOVIET EXPERT ON FMS, BETTER NC MACHINE TOOLS

Moscow PRAVDA in Russian 6 Mar 84 p 2

[Article by P. Belyanin, doctor of technical sciences, winner of Lenin Bonus: "Flexible Production Facilities"]

[Text] The distinguishing feature of the last several decades is the rapid change in the condition and nature of production. It acquires such new qualities as flexibility, efficiency and high level of automation. Interesting creative work on design and control and not on routine work becomes the lot of engineers and workers in the flexible automated production (GAP).

What is GAP and why is it needed? Such a production facility appeared for the first time in our country, and was described about 10 years ago. By the way, this facility is still in operation.

The ideas of using robots and GAP originated almost simultaneously: in fact, both are easily changed to produce new products. The situation is that the development of production and demand led to the sharp expansion of these kinds of products with their complex design, while the time for mastering the productive capacities of new goods and machines decreased sharply. These new trends originated in the background of labor scarcity, especially of skilled workers.

It is not accidental that many managers consider it an exceptional achievement and a rare exception to change the kind of manufactured products without stopping production. In fact, such a change must be an ordinary event, compulsory for a modern high efficiency production facility, always prepared to stop the manufacture of one product rapidly and without loss and in a short time start the manufacture of new products with better consumer qualities.

These are important special features of modern production and are described by the word "flexibility," meaning easy adaptation of production to the market and constantly increasing demands of the people and the needs of the national economy.

In any production, when changing the product manufactured, it is desirable to rebuild the technology as rapidly and inexpensively as possible, without throwing away, in this case, equipment, i.e., preserve past physical and intellectual labor. The GAP makes it possible to do this in the best way



because its technical base consists of equipment with NC, industrial robots and computers, whose readjustment is reduced to replacing programs.

Flexible automation of production is possible on various levels. The lowest level is a kind of a foundation -- a flexible production module. It is easily readjustable and is an independently functioning unit of automated equipment with NC, equipped with devices for loading intermediate products and removing machined parts by robots, feeding and replacing tools and removing waste. The module may not only change rapidly for manufacturing and assembling any parts and units within the technical possibilities of the equipment, but also easily inserting lines or sections in flexible production systems.

A flexible complex -- the basic level of automation -- represents two inter-related flexible modules joined by an automated transport-storage system and an automatic system for providing tools. Synchronization of module operation in this case, as well as control of the entire production cycle is done by a single computer. It insures rapid reprogramming of the equipment for machining (assembling) another part or unit. Flexible modules should be incorporated not piecemeal, but in groups, or better still, by a complex. Only in this case is it expedient to have them operate three shifts.

A flexible automated production facility (shop or plant) consisting of mutually-joined flexible complexes is considered the pinnacle of automation. There is only one way to do this -- full automation of engineering labor and production at all levels, as a result of which together with flexibility, the production acquires "free of charge" high efficiency and economy and becomes almost "unmanned."

Flexibility of production is the highest competitiveness and commercial productivity. Why? The number of workers in the GAP is minimal. The latest achievements in science and technology are best joined in such a production facility. Science is a source of ideas, but without a base, without a production facility, no progress is possible.

Flexible modules and complexes must be incorporated widely, first in small series production of a large list of products. This is acknowledged by scientists and practical people. The argument is about something else: on what basis to build the GAP -- on the basis of new equipment, for example, special machine tools with NC, or use also old equipment. In the first case, the cost of the complexes would be impermissibly high, while in the second case -- labor and money required for "incorporating" traditional equipment would be too high. It is considered most advisable to build the GAP from standardized units and modules. This would increase sharply their "issue," would reduce sharply their cost and simplify their production, making it essentially easier to check out and operate the complexes and the GAP.

It must be added that the design modularity, the wide variety of standardized units, highly prefabricated, with the wide use of computers in planning and design would make it possible to design and introduce flexible modules and complexes four to five times faster than at present. In fact, any machine

tool, welding or other equipment with the required characteristics can be rapidly put together from standardized units. When necessary, such flexible complexes can be disassembled into units and modules and new equipment can be assembled from them with other technical characteristics and save past labor wisely.

The creation and operation of the GAP, requires the development not only of design, but also technological systems for automating the design. We should not forget that modern machinebuilding utilizes over 4000 various technologies, from grinding on lathes to ionic implantation and laser machining and quality control of parts. The equipment is also diverse in kinds and designs and is used for various processes. They, together with the fixture, must be designed in the automated mode on computers.

Computers are needed for this work to optimize solutions. In using the old "manual" methods, it is impossible to complete all this work rapidly, it can be done only by modern high speed computers.

However, for this, it is necessary to develop a large number of automated design and control systems, i.e., make a huge volume of software, with instructions for its use. This is a problem for science. It can be solved only by concentrating and joining scientific forces, for example, into special scientific GAP centers in various machinebuilding centers which, obviously, is better done on the basis of existing industrial technological scientific research institutes without essentially increasing their number.

Scientific GAP centers are already being organized in advanced industrial sectors. Active work began on forming integrated data files; problems are solved on automatic search; storage and transmission in computer networks of all design; as well as technological data. Demands will also increase for specialists capable of working in the special, so-called computer environment, formed not only by various computers, but also by simulation test stands. Training of such specialists must be expanded.

What is the effectiveness of the GAP in the final analysis? So far, little practical experience has been accumulated for flexible automation. However, it already makes it possible to give the following evaluation: the introduction of a flexible complex for machining complicated housing parts on machine tools of the "processing center" type makes it possible to increase the productivity of labor by 2 to 2.5 times and reduce to half the number of machine tools needed to fulfill the plan. At the same time, this will increase the output-capital ratio by 15 to 20 percent, save 20 to 30 percent in turnover capital due to reducing the production cycle for manufacturing parts to about a third.

The GAP will make it possible to improve considerably the standard of production, create conditions for clear-cut rhythmic work of production subdivisions; raise the quality of the manufactured products, change the nature of labor because the share of intellectual labor will increase, while physical labor will be reduced to a minimum. A comparison with traditional machining on universal machine tools indicates the considerably higher efficiency of the GAP.

To this must be added an increase of equipment loading coefficient from 0.9-0.5 to 0.85-0.9, and of the shift coefficient from 1.6 to 2. Moreover, the GAP can operate three shifts. In this case, the composition of workers in the second and third shifts changes drastically, which is especially important from the social viewpoint. For example, about 40 people must work in the first shift of the flexible complex, only four in the second, while in the third, only three persons.

To expand the scale of organizing and introducing the GAP in the current and future five-year plan periods, it is advisable to organize series production of the basic and transport-storage equipment on a standardized basis taking into account modular designs. In particular, it is necessary to organize series production of the new generation of multicoordinate NC devices on the basis of specialized microprocessors for flexible modules to diagnose and search for defect. It is very important, finally, to organize the production of a large number of control micro-and minicomputers, highest level control systems, as well as series production of long-life complementing products, tools and fixtures.

Two problems merit special attention -- the reliability of the GAP equipment and the supply of highly durable tools for them.

Without high reliability of the GAP, it is impossible to develop, in the future, self-learning, self-adjustable and self-restoring, i.e., self-repairing GAP that work around the clock without interruption.

But all this -- in the future. At present, it is necessary to organize mass production of universal, especially, typical flexible modules from which consumer enterprises could assemble in place flexible complexes they need whose prototypes with software must be produced at industrial scientific GAP centers. It is important to do this work widely and very rapidly, and not defer their introduction.

2291

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## AUTOMATED LINES AND AGGREGATED MACHINE SYSTEMS

### BRIEFS

**AUTOMATED PRODUCTION** -- At the Machinebuilding Plant imeni Dzerzhinskiy, a mechanized installation was put into operation for annealing the ends of long cylinders for well pumps. On order of machinebuilders, it was designed by the VNIPTneftemash [All Union Scientific Research and Design Technological Institute of Petroleum Machinebuilding] specialists and manufactured by the experimental plant of the institute. The innovation was efficiently incorporated in the technological process and made it possible to reduce the number of auxiliary workers for transporting the pipe. Previously, the annealing workers had to lift the eight-meter parts weighing up to 50 kilograms, annealed first one and then the second end of the cylinder. Ninety to 100 cylinders were annealed per shift. Now, labor productivity has increased considerably. The installation was erected beside the nitrogen hardening shaft furnaces. A crane was installed that lifts 15 to 20 cylinders simultaneously and places them on the storage device. No manual labor is needed. It is only necessary to press the control button and the pipes roll on the chain conveyor one by one into the heating zone. After annealing, the cylinder is automatically pushed into the bunker. At present, the institute is testing another innovation -- a robotized technological complex also developed on the order of the Plant imeni Dzerzhinskiy. It is intended for threading valve housings for well pumps. It is planned to start up two such complexes this year. The introduction of progressive technology for mechanizing manual labor will help machinebuilders improve the technical-economic indicators. The January plan is overfulfilled. An additional 59,000 rubles of products were sold. The share of products with the Emblem of Quality was 60 percent for a 44 percent per plan. [By K. Manafov][Text][Baku VYSHKA in Russian 22 Feb 84 p 1] 2291

**AUTOMATED ASSEMBLY LINE** -- A flow-mechanized line was installed for assembling rocker machine tools at the Bakinskiy Rabochiy Machinebuilding Plant. The line was designed by specialists of the VNIPTneftemash and made at its experimental plant. Since the start of the year, more than 500 rocker machine tools have been assembled. Manual operations were eliminated and the productivity of labor of assemblers increased by ten percent. The line is serviced by Mekhti Nazarov's brigade. His brigade of 14 men works on a single contract. The line is used by two full shifts. The introduction of the mechanized assembly line and the brigade form of labor organization are the main reserves in raising the productivity of labor of machinebuilders. In 1984, the plant plans to produce 6500 rocker machine tools of various types. This is 815 more than last

year. The plan for January was overfulfilled. Over 500 of them were shipped to customers. At present, the VNIIPneftemash experimental plant is manufacturing a second mechanized assembly line of rocker machine tools on order by the machinebuilders. Its introduction will make it possible to mechanize the assembly of all type-sizes of such rocker machine tools [By K. Manafov] [Text] [Baku VYSHKA in Russian 10 Feb 84 p 1] 2291

AGGREGATED MACHINING SYSTEMS -- Kaluga Oblast -- Production of automatic lines for high precision machining of tractor parts at the Lyudinovsk Machinebuilding Plant of the Ministry of Automobile Industry was mastered. The aggregated machine tools of such a line, electronically controlled, replace the labor of over 30 drillers, lathe operators and milling machine operators. The use of the Lyudinovsk equipment will make it possible to raise the productivity of the machine shops of machinebuilding enterprises and free skilled workers for other production sections. [Text] [Moscow SEL'SKAYA ZHIZN' in Russian 9 Feb 84 p 1] 2291

CSO: 1823/178



## ROBOTICS

### RESISTANCE TO ROBOTS IN SOVIET METALLURGICAL PLANTS NOTED

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 1 Feb 84 p 2

[Article by A. Valentinov, science observer of SOTSIALISTICHESKAYA INDUSTRIYA, under the rubric "Manual Labor on the Shoulders of Machines": "Should a Blast Furnace Have Robots?]

[Text] "In the current five-year plan we intend to introduce 600 robots," said M. Malakhov, chief of the department of the mechanization of technical control of Minchermet [Ministry of Ferrous Metallurgy] of the USSR, pausing to make sure of the impression he had made. "It is true that so far we have introduced slightly more than 100 machines. But in the future the work will proceed at an accelerated pace."

Actually, even for an industry like ferrous metallurgy, 600 robots are an important matter. Especially when you consider that many enterprises today are experiencing a shortage of workers in the basic occupations. In brief, I have already shown how 600 mechanical assistants will show up at blast furnaces and converters, and at the output of rolling mills. The question remains: At which enterprises? In reply, M. Malakhov offered me an impressive document--the ministry's order dated 30 July 1981. It sets down precisely where, when and in which part of industry automatic operators or groups of robots are to be introduced. But acquaintance with this document, to put it mildly, caused me bewilderment.

Judging from it, there is no need for robots at blast furnaces, steel smelters or rolling mills. At least the order makes no mention of them. Just where will the 600 planned mechanical assistants be working? Mentioned are repair shops and the output of consumer goods and other wares. For example in the Tulachermet NPO [Tula Ferrous Metallurgy Scientific and Research Association] a line is being robotized for the manufacture of shovels, which promises to free 40 women workers.

"But these steps will surely not solve the problems of basic industry!"

"Of course not," M. Malakhov agrees. "We have tried to raise the question of using robots in basic industry. But allied plants have categorically refused to undertake the manufacture of them."

The allied plants are Mintyazhmash [Ministry of Heavy and Transport Machine Building] and Minstankoprom [Ministry of the Machine Tool and Tool Building Industry], which in accordance with the accepted division of responsibility should supply metal workers with mechanical assistants. After the issuance of the decree of the CPSU Central Committee and the Council of Ministers of the USSR "Increasing the Production and Introduction into the National Economy of Automatic Operators with Programmed Control (Industrial Robots) in the Years 1981-85" Minchermet of the USSR turned to the machine builders with orders for the development and production of 54 models of specialized robots. But of these orders Mintyazhmash has agreed to accept only four, and Minstankoprom, none.

In the majority of cases the employees of these ministries base their refusals on the fact that "ways of technically accomplishing the tasks are not clear at this time." The argument, we may say frankly, is questionable: any new task begins with the search for possible solutions. Metal workers may fully protest such conclusions, and if necessary carry the quarrel with their allied plants to the national Gosplan. But, as it has been explained, the situation is unique. For example, after giving the metal workers the assignment to introduce 600 robots, Gosplan not only has not determined who will supply them, but has not even allotted the funds.

"Minchermet itself has undertaken to introduce the 600 robots," stated N. Novikov, chief specialist of the machine tool building department of Gosplan, USSR, to whom I had turned for explanations. But his further words made me doubt the sincerity of this "initiative": "We do not intend to require of metal workers 100 percent fulfillment of the assignment--the industry is still not ready for the introduction of robots...."

If you take this point of view, then much becomes understandable: It actually turns a five-year-plan assignment into a good intention. But we can agree with one allegation: ferrous metallurgy is in fact not ready for the introduction of robots. Not technologically, but psychologically. In the industry, and, more precisely, in its staff the comprehension has not matured that the broad introduction of robots and operators is one of the decisive avenues of technical progress.

Nevertheless, when allied plants refuse to help there remains, if not the simplest, yet a genuine approach--the attempt to solve the problem through one's own efforts. The ferrous metallurgy service base is not inferior in capability to two medium machine-building ministries; within the industry there are institutes and KB [design offices] with much experience in mechanizing and automating operations. They are fully capable of producing experimental models of the necessary robots, and of testing them under the conditions of the appropriate industries. And at the same time, deprive the allied plants of their references to the complexity of the task.

Ten years ago the collective of the Dnepropetrovsk institute NIIAchermet (Scientific Research Institute for the Automation of Ferrous Metallurgy) started to produce robots for the refractory industry. Fully automated

lines were developed using them. The first one was assembled in their own experimental plant. Minchermet of the Ukraine then arranged for their manufacture. Today about 40 of these lines are already in operation at enterprises.

"But obviously you need more complex robots for the rolling or the steel smelting industries?", I ask the director of NIIAchermet, Yu. Goncharov.

"These require powerful machines designed for high temperatures and a corrosive medium," he replied. "But already we cannot get along without such machines. A contemporary rolling mill is supported by 10-15 operators and adjusters, whose duty is to control and monitor the operation of the devices. And at the auxiliaries, where the product is sorted, packed and readied for shipment, from 600 to 1,000 men are engaged in difficult operations. To lighten their labors, our colleagues from the neighboring institute VNIImekhchermet [All-Union Scientific-Research Institute for the Mechanization of Ferrous Metallurgy] have produced robots for wrapping bundles of sheet metal. And we are now working on a more complex machine for taking samples of molten steel from the convertors...."

"Who will produce it?"

"We are working with enterprises such as Azovstal and the Novolipetsk and Cherepovets metallurgical combines. There will be a robot--they will find a way to manufacture it...."

This conversation left no doubts: robots are needed in the most important sectors of ferrous metallurgy. Despite all difficulties, they are already being produced, although not on the scale required. Signs of interest are cropping up on the part of enterprises. But in all these processes the ministry is providing weak guidance. Its technical direction is too slight to bring about the unification of the efforts of scientists and specialists to solve the problems of robotization and to extend genuine aid to the enterprises, and it has not attempted to bring about close cooperation with the scientific-design collectives of machine builders.

There is a leading institute on robotization within the industry--the aforementioned VNIImekhchermet. It has been proposed to establish a subdivision of 60 employees in it, who would be responsible for coordinating operations and deciding on the sphere of application of the robots and setting up robotized complexes. But so far only 10 persons are working in this subdivision, who are barely able to handle incoming documents and prepare reports for the ministry.

Understandably, with these resources it is hard to carry out a unified technical policy. As for aid to enterprises, there is clear evidence about that from a conversation with the deputy chief engineer of the Magnitogorsk Metallurgical Combine, M. Kochnevyy:

"We have introduced about 10 robots for stamping metal tableware. So far there has been no discussion about the base of the production. How can

science help us? We concluded an agreement with one of the Moscow institutes: Let the scientists do the surveys and make recommendations on where robots should be used...."

You are right, Magnitka--the ferrous metallurgy enterprises are far from ordinary. And if the future has not been plotted even here, then where should the industry's science be applied? I posed this question to Ye. Borisov, chief engineer, Gipromet, the State Institute for the Design of Metallurgical Plants.

"We are providing for the use of robots in all designs of new and rebuilt plants," replied Yevgeniy Mikhaylovich. "But when the ministry coordinates deliveries with allied plants, not only do the robots disappear, but also all other means of automation. The industry has no more acute current problems on which to concentrate its attention...."

"Unfortunately, this is how things are going," confirmed First Deputy Minister of the Ministry of Ferrous Metallurgy, S. Kolpakov. "Many of our industries are acutely in need of renewal of their basic equipment. Knowing the limited capabilities of machine-building, we are often forced to agree to the minimum level of automation and mechanization. However, if you think of the future, we should not be doing that...."

It is impossible not to agree with this conclusion. Automation of the processes of ferrous metallurgy, including the aid of robots, demands the most fixed attention. To those who do not wish to understand this today I would recall the words of Comrade Yu. V. Andropov: "We must persistently address the accomplishment of the tasks of mechanizing and automating industry, because of the great socio-political importance of this. A man, once delivered from heavy, fatiguing labor, as a rule demonstrates greater initiative and responsibility toward his assigned task."

12697

CSO: 1823/141

## ROBOTICS

### IMPACT OF LATVIAN ROBOTICS INSTITUTE ON INDUSTRY MODERNIZATION

Riga SOVETSKAYA LATVIA in Russian 6 Mar 84 p 2

[Article by E. Davydenko, deputy director of the Robot Equipment Center of the Physics Institute of the Latvian SSR Academy of Sciences, winner of the State Bonus of the republic, "Robots Come to Shops"]

[Text] While only recently robots were a wonder in our republic, now over 300 manipulators and automatic operators have firmly taken their places in the most varied sections of production. The superior attitude toward the clumsy looking mechanisms, which proved in practice that they can ease labor greatly, increase its safety and productivity, has already been forgotten at many enterprises. This effect may be seen especially at production associations BEF [Riga Valsts Elektrotehniska Fabrika], REZ [Riga Electro-Machine Building Plant] and "Radiotekhnika," where robotized complexes and sections already operate successfully.

All this is the result of the great work being done in our republic on introducing robot equipment. For the past three years, a Republic Committee on Robot Equipment at the Latvian SSR Gosplan has been in operation. It includes scientific workers, specialists of industrial enterprises, representatives of party and trade union organizations, and scientific-engineering societies. The commission methodically guides the utilization of robot equipment in the republic, reviews plans of scientific research in this area, the progress of their introduction, and organizes propaganda of achievements in robot building. On its initiative, to accelerate the introduction of robots, formation was begun of a comprehensive program "Development and production of flexible automated production systems using automatic manipulators, robot equipment facilities, machine tools with NC and microprocessors." Its implementation will make it possible to increase the productivity of labor and the product quality of the output at many enterprises.

A Central Interindustrial Design Technological Bureau of Robot Equipment (Robot Equipment Center) with experimental production facilities was organized at the Physics Institute of the Latvian SSR Academy of Sciences. Our center is called upon to coordinate the introduction of robot equipment in the republic enterprises independently of their departmental association; design high efficiency automated equipment; develop promising equipment for robot complexes; and help enterprises manufacture and introduce robot equipment.



In a short time, we were able to fulfill a number of important orders from republic enterprises. Thus, a robot complex was developed to feed parts for the "Avtoelektropribor" Plant. We helped in the development of new progressive loading devices at the "Gidromatpribor" and "Kompessor" plants. In cooperation among the Robot Center and the "Radiotekhnika" Association and the "Avtoelektropribor" Plant, output was organized of seven type-sizes of standardized loading devices for robot equipment complexes and other types of high efficiency equipment.

These devices, developed by Latvian designers, are distinguished by high productivity, the possibility of orienting a wide range of parts in space, rapid readjustability for feeding various kinds of units, and they use relatively little metal. All this insured a wide demand for them, not only in the republic, but also far beyond its boundaries.

The robot center also made a contribution to the organization of production of type MRL automatic manipulators at the BEF, "Radiotekhnika" and REZ associations. These manipulators are used mainly to assemble small units.

There are more and more enterprises in the republic where special groups of workers are organized to develop and introduce robot equipment. Great attention is given to these questions by production associations VEF, "Radiotekhnika," REZ and "Al'fa", and the Riga "Kompessor," the RR Car Building plants, the Olaysk Plastics Processing Plant and the Riga Central Planning-Design Bureau for Mechanization and Automation.

Important steps were taken to train skilled specialists on robot equipment. The Riga Polytechnical Institute trains engineers in the automatic manipulator specialty and in industrial robotized complexes. Robot equipment principles may also be mastered by studying in the Interindustrial Institute of Raising Skills.

The contribution of robot equipment to the intensification of production could have been even greater if all industrial sectors paid the proper attention to its development. However, enterprises in the light, food, fruit and vegetable industries, personal service, commerce, construction material plants and in municipal public service, are slow to introduce robot equipment, citing weak bases and lack of skilled specialists. There is some logic in these arguments, but would it not be much better to combine their efforts and introduce robots, based on local conditions, and not wait for each sector to start manufacturing needed manipulators in a centralized order. Our investigations show that there are many possibilities for this.

A formal approach to introducing these specific means of automation also reduces the efficiency of the robot equipment. There are enterprises which, having received the task of introducing robots, do not especially overburden themselves with preparatory work and worries to increase their useful yield. The specialists usually go to the machine shop and select a simple operation. For example, stamping. They adapt manipulators for its production and report -- the task is completed. What is the sense of such an introduction? In fact,

it is first of all necessary to analyze the entire technological chain, identify bottlenecks, try to solve them by more modern machine tools and technologies, and change the transportation facilities. And only when all other possibilities are exhausted is it necessary to use a robot which, as a rule, is expensive. Therefore, in introducing it, it is especially important to create conditions such that the mechanical helper would work with a maximum load for two to three shifts.

Today, it has been convincingly proven that it is idle to expect special changes in production after introducing one or two robots. A significant effect may be produced only by robotized complexes and sections. In this, one can be convinced with one's eyes, for example, at the VEF Production Association, where production has already begun of flexible automated production facilities, better adapted to frequent changes in products.

Being carried away by a number of robot equipment specialists in automating stamping is of concern. In fact, this operation may be eased and made safer by many kinds of equipment that are simpler than robots. It is much more important to increase the number of mechanical helpers in welding, painting and other heavy unhealthy work.

Of course, introducing a robot is not an easy process; it requires great efforts to overcome technical, psychologic and departmental barriers. But, we are duty bound to be more daring and persistent in overcoming them. This is demanded of us by the decree of the CPSU Central Committee and the USSR Council of Ministers "On measures to accelerate scientific technological progress in the national economy," in which the introduction of robot equipment is acknowledged as one of the most important directions in automating production.

This problem cannot be solved mechanically, caring only about increasing the number of robots. Today, it is so much more important to think of increasing the efficiency of the robot equipment. This obligated management to approach automation of production comprehensively. It means that robot introduction should be preceded by broad rationalization of production and improvement in its structure, and the incorporation of progressive technologies. It pays to use robots only where it is justified technically or economically.

A great amount of work should be done by our center to reduce the number of different kinds of industrial robots used in our republic. In enterprises of various industrial sectors, when introducing robots, it is necessary to standardize manipulator components -- so called modules. This will make it possible to reduce the costs of acquiring equipment, organize a centralized supply of spare parts, simplify starting-adjusting work and repairs of the robots. Aside from the necessity, as they say, of inventing a bicycle every time.

The time has come to think about who will adjust the mechanical helpers. So far, this is done by experts and fans of innovations. But, obviously, there would not be enough of them when mass introduction of robots begins. This is well recognized at the VEF and they train adjusters in their trade school. But,

what about other enterprises? Organize courses? This is unlikely. It means that it is also necessary to organize such robot adjuster groups in other trade schools. There should be enough people who will want to acquire a hitherto nonexistent trade.

Social organizations of ministries, departments and enterprises must play a significant role in introducing robots. In fact, it is very important not only to accelerate the introduction of automation facilities, but also to explain its necessity, teach thrift and the economic operation of expensive robots. Without a doubt, in time, they will become irreplaceable helpers in many shops.

2291

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## ROBOTICS

### BELORUSSIA'S INDUSTRY ROBOTIZATION PROGRAM DISCUSSED

Minsk SOVETSKAYA BELORUSSIYA in Russian 27 Jan 84 p 2

[Article: "Let's Get Acquainted. I'm A Robot!" and commentary by USSR Supreme Soviet Deputy A. T. Klimenkov, machinist in the mining combine of the Beloruskalyi production association and member of the USSR Supreme Soviet's Commission on Science and Technology of the Soviet Union]

[Text] As of the start of this year, two robots in the standard cab sector at the Minsk Tractor Plant imeni V. I. Lenin have been transferred from the ranks of auxiliary workers to high-class welders. They have proven to be reliable, skilled workers during debugging and pilot operation.

Three years ago, the sector workers enclosed a square section and associates from the chief welder's department, together with specialists from the Kiev Arc Welding Institute imeni Ye. O. Paton, began incarnating blueprints in metal by trial and error. There was no experience available -- everything was being done for the first time. But the mechanical welder proved to be a dexterous workman. Fitters Valeriy Matsuta and Sergey Ladutko even taught it to monitor seams and smooth out imperfections in stampings and castings.

Robots from the Minsk Tractor Plant don't feel lonely. They have quite a few "countrymen" in the republic. At another enterprise in the capital, the Termo-plast Plant, 20 robot-technological complexes completely service a third of the press shop equipment. They have become good assistants to Minsk watchmakers as well. At the glass plant imeni Lomonosov in Gomel, an automatic manipulator places cumbersome window glass into packing. Notable successes have been achieved in Brest, Mogilev, Borisov, Volkovysk and Pinsk. During the first two years of the five-year plan, upwards of half a thousand pieces of robot-engineering equipment was enlisted in production. The target scientific-technical program for introducing industrial robots into the Belorussian national economy, which was adopted for the current five-year plan, is being implemented at plants of 13 republic and union-republic ministries. Its implementation, a major first step en route to creating automated plants, will permit the more effective use of the republic's technical potential and material resources. Workers freed from monotonous, physically difficult and sometimes even hazardous labor are acquiring new occupations at enterprise expense. Many of them have already become operators of robot-engineering complexes and direct these intelligent machines.

Compare: as a TASS correspondent reported from Vienna several days ago, this year began poorly for workers in many Austrian enterprises. The management of just one enterprise, the Steiner-Daimler-Pukh automotive concern, reported the dismissal of about 900 workers and employees, effective in February. The reason -- production modernization.

Enterprise retooling has become a scourge for the working man in the countries of capital. No one cares there about what happens to those cast out. A majority of them swell the ranks of the unemployed. And what that means is explained quite graphically by the French magazine PARIS MATCH, which reports that 135,000 French citizens attempt suicide each year, and that among the primary reasons is mass unemployment. The authorities are not (or cannot!) taking real steps to improve the position of the workers. Instead, they have set up the release of a large run of the handbook: "Suicide: The Methods."

[Klimenkov commentary]

"After a while, a robot in production will be as ordinary as a tractor or combine in the fields. The robot-engineering complexes will be developed and serviced by competent specialists which are, since the start of this academic year, being trained at a new target department of Minsk Polytechnical Institute. The "Basic Directions of USSR Economic and Social Development for the 11th Five-Year Plan and Up To 1990" pose the task of strengthening the role of intensive factors, of shifting to machines the most hazardous and difficult and least attractive processes, freeing workers for creative labor.

It would be impossible to overestimate the creative role of science, of scientific-technical progress. There is no longer one branch, one in any way serious production or economic task in the republic which could operate or be resolved without the active participation of scientists. The efforts of academy, VUZ, branch and plant science have been united this five-year period in the implementation of 43 programs on the most important republic scientific-technical problems and seven target comprehensive programs: Labor, Quality, Feed Production, Powder Metallurgy, and others. Belorussia has 23/ scientific-research institutes and planning-design organizations and 400 industrial enterprises participating in 108 Union measures to perfect production and improve product quality.

The fields of science are yielding an increasingly bountiful harvest to republic industry and agriculture. Introduction of innovations just in the first two years of the five-year plan brought an economic impact totalling 63 million rubles, with the development of 115 items of advanced equipment and progressive technological processes, hypothetically freeing about 16,000 people for other work and the issuance of 169 certificates of invention. Here in our association, a semiautomatic control system has been introduced for coal combine operation at the longwall.

No matter how the West tries to portray the Soviet economy as enduring a long period of stagnation, to maintain that crises are just as inherent to socialism as to capitalism, the facts indicate the reverse. Here are just a few figures.

In comparison with 1978, the national income produced in our republic has increased 29 percent. Fixed production assets in all branches of the national



economy have increased 42 percent. Total industrial output production has increased 30 percent, including a 31-percent increase in means of production (Group A) and a 28-percent increase in consumer goods (Group B). Labor productivity growth in industry has been 19 percent.

The amount of output produced per day provides a graphic idea of the opportunities of Belorussian industry. It averages: 91 million kW-hr of electric power, 14,900 tons of mineral fertilizers (recalculated to 100-percent nutrients), 63 metal-cutting machine tools, 253 tractors, 566 tons of paper, 561 tons of cardboard, 260,000 cotton garments and 94,000 items of knit outerwear, 114,000 pairs of leather shoes, 630 motorcycles, 1,997 bicycles, 23,700 watches, 1,760 radios, 2,174 television sets, 1,647 home refrigerators and 828 tons of granulated sugar.

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LEVEL OF ROBOTIZATION OF KAZAKHSTAN INDUSTRY VIEWED

Alma-Ata NARODNOYE KHOZYAYSTVO KAZAKHSTANA in Russian No 9, Sep 83 pp 39-43

[Article by E. Il'gerbayev, chief of the Division for the Integrated Plan for Scientific and Technological Development of the Kazakh SSR State Planning Committee, in the section "Scientific and Technical Progress": "Utilize the Potential of Robotics"]

[Text] The acceleration of scientific and technological progress and transition of the economy to an intensive mode of development is a primary task set by the 26th CPSU congress for the 11th 5-Year Plan. One of the ways of achieving this is by raising labor productivity on the basis of the achievements of science and technology and the further mechanization and automation of production. The Basic Guidelines for the Economic and Social Development of the USSR for 1981-1985 and the period up to 1990 state the following on this score:

"To develop production and ensure extensive application of automatic manipulators (industrial robots) and built-in automatic control systems incorporating microprocessors and microcomputers, and to set up automated shops and plants."

How are these tasks tackled in our republic? The answer to this question is provided by the materials presented here.

Manipulators: Achievements of the Problem

Today we are witnessing the ever-growing introduction of robotics into industrial production. In our country there are already 6,500 automatic manipulators in operation; this is 23 percent of the world fleet. By the end of the 11th 5-Year Plan their numbers are to increase to 40,000. Moreover, robots and manipulators will be employed not only in machine-building, like today, but in other branches of the economy as well: mining, nonferrous and ferrous metallurgy, agriculture, and transport.

Certain developments in this direction are also taking place in Kazakhstan. In accordance with integrated target programs, new machinery and state-of-the-art technologies are being introduced at enterprises, and other measures promoting scientific and technological progress are being implemented. The first two

years of the current 5-Year Plan in the republic saw the introduction of complete mechanization and automation at 16 plants (out of a total of 25 projected in the 5-Year Plan) and at 413 sections, shops and facilities (out of 795); 562 continuous production, integrated mechanized, automated, and integrated automated lines (out of 999) were placed in operation, and 4,086 units of highly productive automatic equipment (out of 8,087 under the plan) were installed. The economic impact of the introduction of innovations is measured in the tens of millions of rubles.

The results of the efforts of creative collectives were especially apparent during the past year. Ministries and agencies of the Kazakh SSR participated in the elaboration of assignments for 75 union and 25 republican target programs. Research and development for these programs and the introduction of the achievements of science and technology in industry were carried out in accordance with the state plan of economic and social development of Kazakhstan for 1982.

Industries within the jurisdiction of the KASSR Council of Ministers carried out more than 300 important scientific and technical progress assignments and implemented more than 30 measures for the introduction and assimilation of highly effective production processes and the manufacture of 65 new types of industrial output. More than 3,300 units of production and technological equipment were modernized at enterprises, new integrated mechanized and automated lines have appeared, and a number of other measures for raising labor productivity were carried out. The total economic payoff from all of this was 55.2 million rubles.

Technical progress has spread to different branches of industry. It has drawn into its orbit such major enterprises as the Ust'-Kamenogorsk Lead and Zinc and the Balkhash Mining and Metallurgical Works, the Mirgalimsay ore mines and some Karaganda mines, the Ekibastuz GRES-1 district power plant, the Aktyubinsk heat and power plant, and many others.

However, the above-mentioned undertakings in scientific and technological progress are still inadequate for solving all the economic and social problems currently facing the republic's industry. One such problem remains that of reducing the proportion of manual labor and replacing workers with machines, especially on laborious, harmful or health hazardous jobs. It can be resolved only through the extensive use of automatic program-controlled manipulators (industrial robots).

As mentioned before, much is being done in the Soviet Union to develop robotics and introduce it in production. Creative teams in our republic are also contributing to this to the best of their abilities.

In 1981 the Central Committee of the Kazakhstan Communist Party and the Kazakh SSR Council of Ministers issued a special decree on this score. Pursuant to it the republic's ministries and agencies defined the types of operations that should be performed by automatic manipulators and set forth their views on developing them. All the materials have been forwarded to the union machine-building ministries. Initial requirements are for some 890 industrial robots

and 130 manually operated manipulators. Thus, the development and introduction of automatic manipulators is centralized.

In nonferrous metallurgy, the leading organization for supplying plants with automatic manipulators is the Soyuzsvetmetavtomatika scientific-production association, which prepares assignments for the machine-building ministries to develop the needed prototypes in accordance with received requests. Notably, for Kazakhstan plants it has identified program-controlled manipulators and sets of equipment with manipulators to be used for taking samples of liquid materials operating in analytical monitoring systems for production processes at concentrating mills, and also for controlling processes in metallurgy. The need is for 190 units, and their manufacture has been assigned to plants of the USSR Ministry of Heavy and Transport Machine Building.

In the building materials industry, automatic manipulators are being developed by the Glavsantekhprom central planning, design and technical office. The republic ministry has provided it with the initial technical and economic data for the development and manufacture of three automatic manipulators for grading and packing glazed ceramic tiles and floor tiles for the Tselinograd Ceramics Works.

On instructions of the USSR Ministry of the Light Industry, five base plants have been designated in the republic in different branches of the industry to conduct production tests and introduction of new labor mechanization equipment. The idea is to employ manipulators at such hard, harmful and hazardous jobs as feeding dye chemicals into boiling vats at textile and knitwear mills, lifting and installing electric motors on benches in electrical shops, unloading heavy workpieces in mechanical shops, and loading-unloading operations at warehouses. For these jobs requests have been submitted for 40 KSh-63 pneumatic cantilever-articulated manipulators and 33 ShBM electric articulated balance manipulators.

Among the organizations contributing to efforts to develop and introduce manipulators are a branch scientific research laboratory at the Dzhambul Technological Institute of the Light and Food Industry and the Kazakh State University imeni Kirov, with which plants of the Ministry of the Light Industry have signed a creative collaboration contract.

The KaSSR Ministry of the Food Industry has set the task of employing automatic manipulators with a rated load capacity of 25 Kg and a handling capacity of 800 items per hour for loading and unloading finished products into and from railroad cars, as well as manipulators with a handling capacity of 500 to 800 kg per hour for loading and unloading vacuum pans and open boiling vats (for a total of 10 types of jobs), manufacture of which will be set up in the system of the USSR Ministry of Machine Building for Light and Food Industry and Household Appliances.

These are not just plans. Much of what has been planned is being put into effect. Thus, according to data of the KaSSR Central Statistical Administration, 52 numerical controlled metal-cutting machine tools, 19 program-controlled automatic manipulators, three balanced manipulators, and 14 automatic electroplating operators will be installed at the republic's machine-



building, machine-tool and instrument building plants (the Alma-Ata Machine-Tool Building Plant, the Kentau Excavator Plant, the Karaganda Mining Equipment Plant, and others).

In nonferrous metallurgy, 10 automatic manipulators each have been introduced under the program of reducing manual labor at the Dzhezkazgan Mining-Metallurgical and Achisay Polymetallic Works. In the system of the Ministry of Geology, five semiautomatic complexes for round-trip operations to a depth of up to 300 meters have been built and are currently being introduced. Remote-controlled manipulators are in use at warehouses of the Pavlodar and Taldy-Kurgan automobile repair plants. All in all, last year 92 manipulators and 35 industrial robots of different types were placed in operation in the republic.

The Tselinogradsel'mash agricultural machinery production association is using SM40Ts-4011 robots in loading and unloading operations, and RPD-1.25 and PRTs-1 robots in stamping and forging. The Ural'sk Mechanical Plant uses Bulgarian Beros RB-232 robots, and the Geotekhnika plant in Aktyubinsk has model RE-11050, and MNO-20, 50, and 70 welding robots. The Aktyubrentgen plant has five type MP-9S robots and is planning the extensive use of automatic manipulators for manufacturing toys ("Soccer," "Hockey," etc.).

Manipulators and industrial robots are also used at the Petropavlovsk Machine-Building Plant, the RGTO plant in Karaganda, the Aktyubinsk plant of reinforced concrete railroad ties, the Tselinograd Building Materials Works, and a number of other enterprises.

Work is continuing in the republic on the further introduction of robotics in production. For example, currently it is planned to install 55 program-controlled automatic manipulators at ferrous metallurgy plants and four at meat-and-dairy plants, an automatic mineral wool packing machine and an automatic silicate brick stacker in the building materials industry, and a manipulator for welding garbage containers at the experimental municipal equipment plant in Taldy-Kurgan. The "Kzyl tu" production association, with the collaboration and active participation of associates of the Kazakh Polytechnical Institute, is placing in operation a Tsiklon-3B robot manipulator for molding thermosetting plastics.

Scientists are making important contributions to the acceleration of scientific and technical progress. Institutes of the Kazakhstan Academy of Sciences are carrying out important research, development and design projects under the Union program. Thus, the Mining Institute has undertaken to develop a robotics complex for mining hard ores in complex geological conditions. The Presidium of the Academy of Sciences and the State Committee for Science and Technology have allocated appropriate funds for these purposes.

Other institutions engaged in research, development and designing aimed at developing and introducing robots and robotized systems in production include the Kazakh State University, the Kazakh and Karaganda Polytechnical Institutes, the Alma-Ata Power Institute, and the Pavlodar Industrial Institute. Researchers of the Kazakh State University, for example, are studying the possibilities of developing new robot mechanisms, control systems for them, and testing



facilities for robotized systems. Under contract with the KaSSR Ministry of Highways, they are elaborating principals of utilization of robots and manipulators in highway construction. This year's plan provides for the development of a pilot remote-controlled manipulator for painting road signs.

The Kazakh Polytechnical Institute is under contract with the Ministry of Local Industry to design the circuit of a manipulator for an electrical armature and fixtures die forging press.

Associates of the Karaganda Polytechnical Institute have developed a universal telemechanical system for controlling a rubble crusher which is capable of operating with any types of manipulators performing linear and angular displacements.

The Alma-Ata Power Institute is developing a robot caster for precise batching and pressure casting of liquid aluminum from the furnace into the casting machine. The production forms and records and operating system have been completed and an industrial pilot specimen has been built and successfully tested.

The KaSSR Ministry of Motor Transport's Scientific Research and Design Institute of Motor Transport (KazNIPIAT) has set up a laboratory for developing and providing methodological guidance for the introduction of automation means and robotics in the industry. Studies and experimental design work are continuing on the development of robots and manipulators in the republican Ministry of Geology and in research establishments of a number of other ministries and agencies.

At the same time, specialists are being trained in the technology of robotized production. Training is offered by the Kazakh and Karaganda Polytechnical Institutes as well as by several vocational and technical schools. In particular, the Balkhash, Tselinograd and Kentau state vocational and technical schools and the Ural'sk Technical School No. 5 are using experimental study plans and curriculums to train 112 persons in setting up automatic machine tools and manipulators.

As we see, quite a lot has been and is being done for promoting scientific and technical progress in Kazakhstan. Nevertheless, we so far have no reason to flatter ourselves with our achievements. We cannot deny the fact that there are certain difficulties along the road of introducing the achievements of science and technology into production, there are brakes, serious shortcomings and failures. There are reasons for this.

Robotization of production has never been undertaken in the republic before. It is, in effect, only just beginning and these are so to say its first tentative steps. It is, therefore, only natural that its results are still not very tangible and the economic impact of the introduction of robotics is still insignificant. Thus, the introduction of 26 numerical controlled machine tools and special and modular equipment at machine-tool and instrument building plants over two years of the 5-year plan made it possible to save only 118,700 rubles on cost reduction. The use of 11 industrial robots and four electro-

plating transfer arms resulted in a saving of only 24,600 rubles. These are, of course, not encouraging numbers.

The thing is that some scientific and technical innovations are used at our enterprises in only very limited numbers. Obviously, within the total production volume they could not yield tangible results or assure highly efficient operation. Practical experience reveals that this can be achieved only by going over from installing individual robots and manipulators isolated from the overall production process to the development of interconnected robotized complexes and systems, that is, sections, shops and large-scale production facilities.

Moreover, it is not only robotization that yields a low payoff. This is equally true of equipment for the mechanization and automation of production processes. Here too, we will quote data of the KaSSR Central Statistical Administration.

Studies carried out by the administration in 1981 at 2,385 enterprises revealed that much of the newly installed equipment is operating one shift and well below its capabilities. More than 1,830 mechanized flow lines and 288 automated lines have not attained their design output.

At some plants transfer lines are operated at less than one-half capacity. This is true, in particular, of the Chinkent and Alma-Ata bakery production associations of the republican Ministry of the Food Industry, the Karaganda Structural Plastics Works of the Ministry of Building materials, and the Kitap production association of the KaSSR State Committee for Publishing Houses, Printing Plants, and the Book Trade.

As a consequence of unsatisfactory capacity and shift utilization of transfer lines and the low level of mechanization of auxiliary processes at inspected enterprises, the proportion of manual labor remains very high. Overall throughout the republic it was 24 percent on mechanized flow lines and 19 percent on automatic lines. Manual labor was 56 percent on mechanized flowlines and 29 percent on automatic flowlines of enterprises of the Ministry of the Meat and Dairy Industry, respectively 40 and 14 percent in the Ministry of the Forestry and Timber Industry, 33 and 23 percent in the Ministry of the Fruit and Vegetable Industry, and 22 and 67 percent in the State Committee for Publishing Houses, Printing Plants, and the Book Trade.

That was in 1981, but little has changed since then. That is why a session of the collegium of the KaSSR State Planning Committee, with the participation of republican ministry and department executives, specifically considered the state of affairs and prospects of robotization in industrial production.

The collegium noted that, with the exception of the Ministry of Nonferrous Metallurgy and the Ministry of Housing and Municipal Services, none of the ministries or departments included assignments for the installation of robots and automatic manipulators in the republic's 1983 plan of economic and social development. Still less, of course, has anyone reflected on the draft plan for the development of science and technology in 1984.

The situation is especially bad with the introduction of robotics at enterprises and economic organizations of the Ministries of Water Administration, Consumer Services, the Forestry Industry, Light Industry, the Food Industry, the Construction Materials Industry, Construction of Heavy Industry Enterprises, and several other ministries and agencies. Their executives clearly underestimate the opportunities of automation means.

To some extent one can understand such executives. The introduction of new developments, especially those which have not yet been extensively endorsed, is a considerable risk. However, without reasonable and justifiable risks, without daring it's impossible to advance, to assure the acceleration of scientific and technical progress and the upgrading of social production on this basis.

Guided by the appropriate decisions of the party and the government, the Gosplan collegium outlined specific measures aimed at overcoming existing shortcomings and the more extensive introduction of the achievements of science and technology at the republic's enterprises.

Integrated mechanization and automation of production processes, a sharp reduction in the use of manual labor, and an all-out increase in labor productivity lie at the core of the Communist Party's economic and social policies. In his speech at the June (1983) plenum of the CPSU Central Committee, Comrade Yu. V. Andropov once again stressed:

"The widespread use of robots, especially at production sections where manual, arduous physical, unskilled and monotonous labor is still used, will radically alter the situation in the field of labor productivity. It will make it possible for hundreds of thousands of people to work in different, more favorable conditions and gain greater satisfaction from their work... This will bring closer solution of one of the basic problems of communist construction: the problem of overcoming major differences between physical and manual labor."

The creative quests, all the efforts of our scientists and specialists, workers, engineering and technical personnel should now be directed at implementing this task. The greater the contribution of each to the common effort the sooner will this objective be attained.

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CONTROL ALGORITHMS OF SOVIET HCS 'RUSALKA' FOR ROBOTS ANALYZED

Bratislava POCHTACE A UMELE INTELIGENCIA in Russian Vol 1, No 1 Feb 82  
pp 83-96

[Article by Andrey Aleksandrovich Petrov: "Combined Control of a Manipulation Robot in a Complex Medium." Institute of Control Problems, Profsoyuznaya Street, USSR II 734 22 Moscow]

[Text] Abstract

This article is devoted to the analysis of control algorithms of robots, oriented toward the hybrid computer as the control system. The Soviet hybrid computing system ("HCS") "Rusalka" and the anthropomorphic robot, developed in the MVTU [Higher Technical School imeni N. E. Bauman] with six degrees of freedom are used. The method of determining the allowed trajectory of the motion in case the trajectory is bypassed is presented. The presented algorithm of planning and organizing the robot's motion, realized on the hybrid computer, allows the efficient disparallelizing of computing, which again allows a motion generation in a real or accelerated time scale. This property is used to identify the parameters of the real model and for the goals of adaptation. The advantages of the algorithms referred to are demonstrated with the specific examples.

General Review of the Problem

The solution of the most important problems in producing efficient integrated robot information control systems is impossible without the wide use of modern computers at all stages of developing, researching and the functioning of the robots: in design calculations of robot equipment systems, in debugging control algorithms and analyzing information by machine simulation methods, and in the operation of computers directly in the control loop. The problems of automating the design and machine simulation of robots demand the realization of essentially nonlinear models of dynamic systems with a large number of degrees of freedom. In this case, it is frequently impossible to do without semireal investigations involving the connection of models with components of a real robot equipment system in the loop, for which it is necessary to have developed possibilities for joining computers with external apparatus and for simulating in real time. In carrying out machine and semireal experiments, it is very important to have the convenience and flexibility of interaction between the investigator and the model which requires extensive



additional expenditures of computer resources in order to provide interactive working modes. Direct use of computers within the information control system of the robot has the following special features:

a mandatory requirement of calculating in real (and in a number of cases also in the accelerated) time scale;

advisability of disparalleling the computation procedures for various functional subsystems of the robot and on various hierarchy levels.

This report reviews work done in recent years in the Institute of Control Problems on using HCS to simulate robot equipment control systems and on developing hybrid-oriented control algorithms for manipulating robots.

This work is based on the Soviet HCS "Rusalka" [4, 5] -- a universal balanced HCS of the third generation. The digital part of this system has a two-level hierarchy and consists of M-4030 and M-400 digital computers. The analog part consists of several EMU-200 frames, connected to the general control console; each frame includes 220 linear and 48 nonlinear decision components, as well as a developed system of parallel logic, comparators, electronic keys, relays and digitally-controlled coefficients. The accuracy of the analog operations reaches 0.1 percent, while the maximum frequency of division into periods of the solutions is 2kHz. The analog and digital parts are interlinked by analog-digital (64 channels) and digital-analog (32 channels) converters, as well as by 58 communications lines that provide for the exchange of control data. The "Rusalka" HCS is equipped with well-developed hybrid software and a convenient system for debugging the programs.

On this basis, it is proposed to organize a hybrid simulating set, oriented toward developing and investigating integrated robot information control systems in machine and semireal experiments. Here, the method of semireal simulation opens up especially promising prospects. Actually, the availability of fairly full models of functional subsystems of the robots or of their individual units, in real HCB, to which are connected real robot actuators and sensors that supply data on the actual condition of the robot and its environment, as well as other real apparatus, produces great possibilities for comparing various methods and algorithms for control and processing data, for selecting designs and parameters of information-control systems, for their debugging and experimental checks. It is important that simulating on HCS makes it possible to find the most efficient distribution of functions between the digital and analog parts of the system and to identify the basic technical requirements of the devices being developed and their components. The model developed in semireal experiments on a universal HCS can serve as a direct prototype for producing specialized computer units with an apparatus-program realization of the information-control system.

The "Rusalka" HCS was linked to an anthropomorphic electromechanical manipulator design of the MVTU [6] which has six degrees of mobility, not counting the grip. The linkage system provides the following: a two-way connection of "power" units to control the manipulator with HCS frames; simple connections



of sensors and other components of real robot equipment systems, as well as the possibility of remote control of the analog and digital parts of the HCS by the experimenter, who is far from the system, but quite near the working zone of the manipulating robot.

Moreover, an algorithmic software was developed for robot equipment problems that makes it possible to achieve an interactive mode of simulating robots which presents the operator with wide possibilities for interaction with the hybrid set in the process of machine and semireal experiments, registration, processing and representing the experimental data and the simulation results. The hybrid method for visualizing data on robot movements on the display screen is described in [1].

#### Problem Selection and Formulation

The described computers and apparatus-program software that are the basis of the simulation set were used widely in developing hybrid-oriented methods and algorithms of an integrated manipulation robot in a complicated environment. In implementing various production or research operations, the robot must transfer the grip (working tool) of the manipulator to the needed point in space with the required orientation, or move it along some curve according to a given spatial-time law. In this case, the mandatory requirement is the prevention of collisions between manipulator links and external obstacles which may be previously unknown to the robot.

A typical manipulator represents, in the general case, a multilink spatial open kinematic circuit with hinged or other articulation, provided with drives. As an object of control, it is a complex multiply-connected system with a great number of controlled degrees of mobility and with essentially nonlinear kinematics and dynamics. The achievement of the desired changes in the position of such a multilink mechanism in space, requires the formulation of controlling actions for each degree of mobility that would provide for their coordinated change in time, taking into account the dynamic characteristics of the object, which may change considerably in the process of movement.

The current configuration of a manipulator with  $n$  degrees of mobility for a given kinematic arrangement and geometrical parameters is determined fully by an  $n$ -dimensional vector  $\theta = (\theta_1, \theta_2, \dots, \theta_n)$  of generalized coordinates for which usually angular and forward motions in the joints of the links are used. As a rule, the following limitations of the form

$$\theta_{min} \leq \theta \leq \theta_{max} \quad (1)$$

are imposed on changes of the generalized coordinates due to design considerations.

The system dynamics model, generally speaking, must take into account not only the gravitational and inertial components of moments and forces, acting in the joints of the manipulator and the dynamic properties of drives for all degrees of mobility, but also their interaction, i.e., centrifugal and Coriolis force components of the moments. A number of methods is known for deriving equations for the actuating system dynamics of manipulation robots (see, for example, [6, 7]) and it is considered that a fairly adequate model must be described by a system of nonlinear differential equations of the  $2n$  order as a minimum. We will consider models of the form

$$M(\theta, C_1)\ddot{\theta} + H(\theta, \dot{\theta}, C_2) = U(t) \quad (2)$$

(initial conditions  $\theta(t_0) = \theta^0, \dot{\theta}(t_0) = v^0$  are considered to be known), where  $M$  -- functional matrix of dimensionality  $n \times n$ ,  $H$  --  $n$ -dimensional nonlinear vector - function,  $C_1$  and  $C_2$  -- vectors of parameters,  $U$  --  $n$ -dimensional control vector that satisfies limitations

$$U_{\min} \leq U \leq U_{\max} \quad (3)$$

The problems for controlling purposeful movements of the manipulation robot in a complicated environment is divided into two subproblems:

- 1) form desired laws of coordinated changes in the generalized coordinates  $\theta(t)$ , corresponding to the execution of the set target without colliding with obstacles and violating design limitations;
- 2) obtain  $U(t)$  to debug the formed laws for drives of each degree of mobility taking into account the dynamic characteristics of the system.

The second subproblem is a fairly traditional control problem, but is distinguished by the complexity of describing the object (2), that does not permit the efficient use of analytical methods to calculate this part of the robot control system. At present, debugging of given (program) changes in generalized coordinates in most of the known robots is done by tracking systems which, by using more or less complicated methods, eliminate the mismatch  $\|\angle \theta\|$  between the current and the program states. In view of the extremely strong relationship between the dynamic properties of the object and the current configuration of the manipulator, it is not a simple problem [7] to obtain high quality tracking characteristics.

Another known approach uses, instead of a tracking system, direct drive control in an open loop by calculating the required "program"  $U(t)$  on the basis of solving the inverse dynamic problem [8]. Various combinations of open and closed control principles are also used in which calculated values of  $U(t)$  are used as additional signals to correct tracking systems (see [7-9]).



the set of the points  $P \subset E^3$  they occupy (possibly, supplemented by some set of a buffer "safety zone" surrounding the obstacles).

The effector system deals with generalized coordinates and it is natural to describe for it a "world model" in space  $\Theta = \{\theta_1, \theta_2, \dots, \theta_n\}$  (or even in phase spaces of generalized coordinates). Limitations (1) define in space  $\Theta$  an  $n$ -dimensional parallelepiped  $\Gamma$ , to which correspond in the three-dimensional operating space manipulator positions allowed by the design that form set  $G \subset E^3$ . Changing  $\Gamma$  into  $G$  is done by conversion

$$g = F(\theta), g \in G, \theta \in \Gamma, \quad (4)$$

that gives unambiguously the coordinates of the manipulator's points for a given  $\theta$  in the selected "absolute" counting system in  $E^3$ . When there are obstacles in the working environment, a subset  $G_p$  of "permitted" spatial positions of the manipulator is separated out from  $G$ , in which none of the points in the subset belongs to  $P$ . For a given manipulator, the permitted region  $\Gamma_p \subset \Gamma$  will correspond unambiguously to the subset.

Speaking of the planning subset, we will note that if to determine the mutual positions between the manipulator and obstacle, data is required about all points on its surface in  $E^3$  (i.e., a check of condition  $g \in G_p$ ), then when assigning the movement target of the manipulator data is usually being processed only for a comparatively small number of its specific points (end links, grip, etc.). Therefore, it is convenient to introduce into consideration an assignment space  $Z$  -- a space of vectors  $r$ , whose components are coordinates of the specific points of the manipulator of interest to us (in the absolute or some other selected counting system). In practice, vector  $r$  most frequently characterizes the condition of the manipulator's grip (for example, its position and orientation). Then, having indicated the point or trajectory in space  $Z$ , a system may be assigned for planning the required target of movement, say, to reach the desired state  $r = r_{\text{nc}}$  or to change  $r$  according to a needed law  $r = r_{\text{nc}}(t)$ . Along with (4), we will consider a simpler transformation

$$r = f(\theta), r \in Z, \theta \in \Theta. \quad (5)$$

Mathematically (4) and (5) are given in the form of a superposition of sequential transfers between coordinates systems, related to the links of the manipulator (see, for example, [6, 7, 9]).

Thus, the robot planning system must use at least three "models of the world:" having obtained data on the movement target in terms of assignment space  $Z$ , it must develop a permitted trajectory  $\theta(t)$  in space  $\Theta$ , providing, in this case, for by-passing obstacles  $P$  in  $E^3$ . In most known approaches to the solution of this problem, the greatest attention has been given to working with a world model in a three-dimensional working space  $E^3$ . Frequently, the working medium is considered known beforehand and, in forming movements, heuristic methods are widely used of the type: "pass above the highest obstacle" [9, 10]. In a number of robots, it is proposed to assign sub-targets -- intermediate states.

$$r^k \in Z \quad (k = 0, 1, \dots, N, \quad r^0 = f(\theta^0)r^* = r_*, \quad r^N = r_f).$$

to each of which correspond a permitted position of the manipulator in  $E^3$ . In this case, it is necessary to find the value of vector  $\theta^k$  in the assignment space by an inverse transformation  $\theta^k = f^{-1}(r^k)$ , then having made transformation  $g^k = F(\theta^k)$ , check condition  $g^k \subset G_p$ . This check is achieved either by calculating the distance between the manipulator and known obstacle in  $E^3$  (usually obstacles are approximated by geometrical bodies), or the presence of a system is assumed capable of measuring this distance effectively. When there is danger of a collision between some point of the manipulator and the obstacle, the next subtarget is obtained heuristically or by means of algorithms that would move the given point out of the danger zone (see, for example [12, 13]), while in the case of danger to several links of the manipulator at once, these algorithms may impose contradictory requirements, leading to the "cycling" of movements. If, however, it was possible to obtain permitted  $g^k$ ,  $\theta^k = F^{-1}(g^k)$  are plotted, connecting them according to some interpolation formula and the sought-for law  $\theta(t)$  is formed [6, 9]. The necessity of making multiple complicated inverse transformations makes it quite difficult to realize methods based on planning sequential positions of the manipulator in  $E^3$ .

For this reason, proposals for plotting the searched-for law directly in space  $\Theta$  [3, 6, 10, 14-17] is more preferable. In this case, it is necessary to track not a large number of points on the manipulator surface, but only one  $n$ -dimensional point  $\theta$ , not permitting it to fall into forbidden zone

$\Sigma$ , which supplements permitted region  $\Gamma_p$  up to entire space  $\Theta$ . To by-pass forbidden zones for a fully known  $\Sigma \subset \Theta$  it was proposed to use algorithms based on searching for paths on graphs and mathematical programming methods [6, 14-17].

However, work on representing knowledge in space  $\Theta$  was restricted by the following circumstances. Firstly, to plot zone  $\Sigma \subset \Theta$ , as a rule, at first  $P \subset E^3$  was determined, i.e., a model of the world was plotted in the working zone considered as an unavoidable intermediate stage. This required the availability of a developed perception system, capable of recognizing fairly fully and accurately the kind of obstacles and measure their parameters. So far, such a "global" analysis of the situation in real time is difficult. Secondly, although it is possible to plot zone  $\Sigma$  fully in  $n$ -dimensional



space  $\Theta$  [17] according to known  $P$ , storing and utilizing this data requires fairly considerable space in the memory and considerable machine time. And, thirdly, for interesting manipulation problems zone  $\Sigma$  usually turns out to be nonconvex, "labyrinth-like," and related to methods proposed in [6, 4-16] the excess of "cul-de-sacs" fraught with either full scanning of region  $r_p$ , or "cycling" of the trajectory of the point to which the above-mentioned "cycling" of the manipulator movements correspond.

#### Selection of Methods of Solving the Problem and Solution Results

Our papers [3, 4, 10, 17] were directed to the development of such a hybrid-oriented method for forming  $\theta(t) \in r_p$ , that it would not require full knowledge of the global view of zone  $\Sigma$  to by-pass it without getting stuck in cul-de-sacs and, therefore, could operate with a simple sensor system which would give only "local" information on the appearance of obstacles near the manipulator when it moves. Without considering the technical problems of designing such sensors here, we will note, however, that in their functions, they are very much simpler than technical vision systems and even simpler than tactile sensors of the "artificial skin" type proposed in [14], from which it was required to determine the point of contact with the obstacle and plot a normal to the surface. For the described method, it is only necessary to signal the very fact that the image point is in some vicinity of the forbidden zone, for example, when it approaches fairly close distance  $\sigma$  to it.

The idea of the method is that in the safe region, the image point must approach steadily the target point  $\theta^*$ , which satisfies equality  $f(\theta^*) = r_{mc}$  ( $r_{mc}$  is considered given, because there exists at least one  $\theta^* \in r_p$ ), while in the vicinity  $\sigma$  of zone  $\Sigma$ , it moves along the zone's boundary as long as there is no possibility for it to return again to free movement, known to be one that excludes "cycling".

Taking into account the advantages of realizing the sought-for trajectory in the HCS, it is expedient to obtain the solution of the following system of the usual differential equations:

$$\tau \ddot{\theta} + \dot{\theta} = -K \nabla W + S\theta, \theta(t_c) = \theta^0 \in r_p, \dot{\theta}(t_c)$$

where  $\tau$  and  $K$  -- diagonal matrices of constant coefficients, that take into account the dynamic possibilities of the actuators;  $\nabla W$  -- gradient (or quasigradient) of an  $n$ -dimensional vector-function of misalignment  $W = \|f(\theta) - r_{mc}\|$ , the zero minimum of which corresponds to reaching the desired position;  $S(\theta)$  --  $n$ -dimensional vector-function, that prevents the image point from getting into the forbidden zone. It is easy to see that solution (6) in free space (for  $S(\theta) = 0$ ) insures reaching the target with an accuracy  $\varepsilon \gg \varepsilon_0 > 0$  given beforehand, i.e., there will always be a moment of time  $T = T(\varepsilon, \theta^0)$  such that for  $t > T$  inequality  $\|f(\theta) - r_{mc}\| \leq \varepsilon$

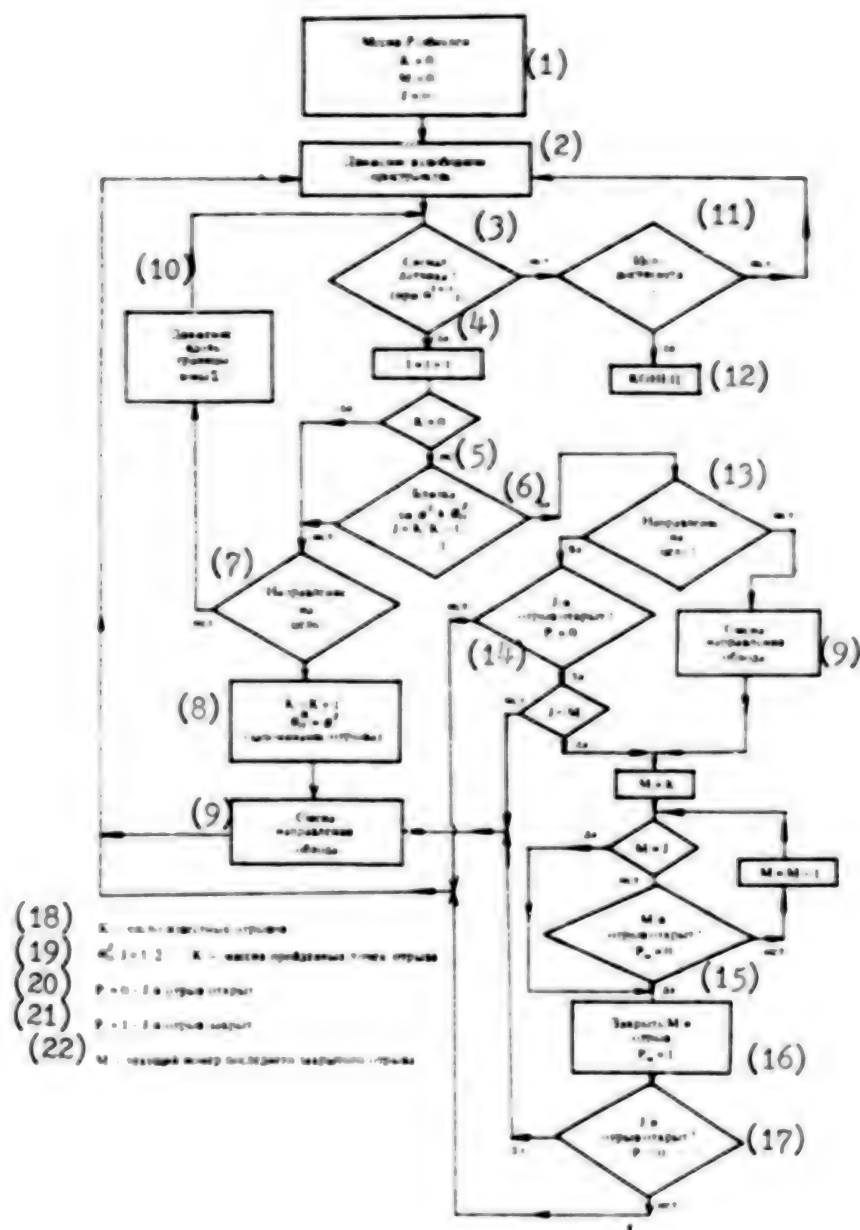


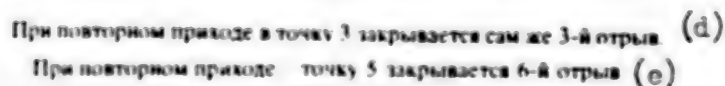
Fig. 2. 1 -- file  $P = 0$ ; 2 -- movement in free space; 3 -- sensor signal ? (at  $\theta^{i+1}$ ); 4 -- yes; 5 -- no; 6 -- is  $\theta^i$  near  $\theta_0^j$ ; 7 -- direction to target?; 8 -- (break storage); 9 -- change in by-pass direction; 10 -- movement along boundary of zone  $\Xi$ ; 11 -- target reached; 12 -- end; 13 -- direction to target; 14 -- J-th break open?; 15 -- M-th break open ?; 16 -- close M-th break; 17 -- J-th break open ?; 18 -- number of known breaks; 19 -- file of passed break points; 20 -- 0-J-th break open; 21 -- 1-J-th break closed; 22 -- current number of the last closed break.

will be true. Moreover, using the gradient system of the second order insures the existence of the first and second derivatives of  $\theta(t)$ , i.e., a sufficient smoothness of the obtained trajectory for movement toward the target. If the manipulator finds itself dangerously close to an obstacle, i.e., the image point enters the vicinity of zone  $\Sigma$  at point  $\theta'$ , then to fulfill conditions  $\theta(t) \in \Gamma$  for all  $t \geq t_0$ , it is necessary to include function  $S(\theta)$  so as to "brake" the movement of the image point in the previous direction, having neutralized "traction force"  $-K \nabla W$ , and then force the image point to move along the boundary of zone  $\Sigma$  without getting stuck in the cul-de-sacs.

It was proposed in [10] to form a "local bulge" in the boundary of the forbidden zone, building in the vicinity of point  $\theta'$  an auxiliary standard obstacle, for example, a sphere with a small radius  $\rho$  with the center at a distance of  $\Delta < \rho$  from  $\theta'$  along the velocity vector of the image point at the moment a signal is received from the sensor of approaching the obstacle. In by-passing this auxiliary standard zone (for example, by means of function  $S(\theta)$ , formed by two components -- a penalty function which insures radial braking of the image point, and a tangential component which forces it to move along the surface of the auxiliary obstacle), the image point sooner or later will again enter the vicinity of  $\Sigma$  of the forbidden zone at another point  $\theta^2$ , after which the described procedure should be repeated, having transposed the auxiliary obstacle to the vicinity of  $\theta^2$  and "joining" solutions (6) for these steps according to initial conditions. It is obvious that this method insures sequential advancement along the boundary of even nonconvex zones of  $\Sigma$  without getting stuck in the cul-de-sacs.

It is not always necessary to "break away" from the boundary, when such a possibility appears, to return to the trajectory of free movement to target with  $S(\theta) = 0$ , but only at those points where it is known that "cycling" of the trajectory movement will not occur.

The selection of such points of the general kind for an  $n$ -dimensional space is very complicated, however, as shown by simulation, for very many practically important manipulation problems in specific cases correspond to such trajectories  $\theta(t)$ , which lie in sections of the  $n$ -dimensional space  $\mathcal{C}$  in a plane (or other two-dimensional surface), or may be formed by sequential transitions from one plane section (section by a two-dimensional surface) to another. For the case, however, when  $n=2$  (this case has large independent importance since it concerns problems of route selection for mobile robots in a complicated environment), it is possible to propose an entire series of algorithms for selecting break points that differ in the degree of complexity of the logic procedures.



For example, a break may be permitted only when the direction of the tangential component of the velocity vector of the image point movement along the boundary of zone  $\leq$  coincides with the direction of antigradient  $\nabla W$ . Obviously, after the break, the image point may approach another section of  $\leq$  and, passing along the boundary, again get to the previously met break point. To avoid "cycling" at the new "collision" point, after each break, it is necessary to select one of two possible directions to by-pass the forbidden zone according to the logic of the block diagram in Fig. 2 (see also Fig. 3). We will differentiate between "closed" and "open" breaks: after a closed break the direction of the by-pass is maintained; after an open break, it changes to the opposite direction. The new break points encountered on the way are at first considered open and are memorized in the process of passing.

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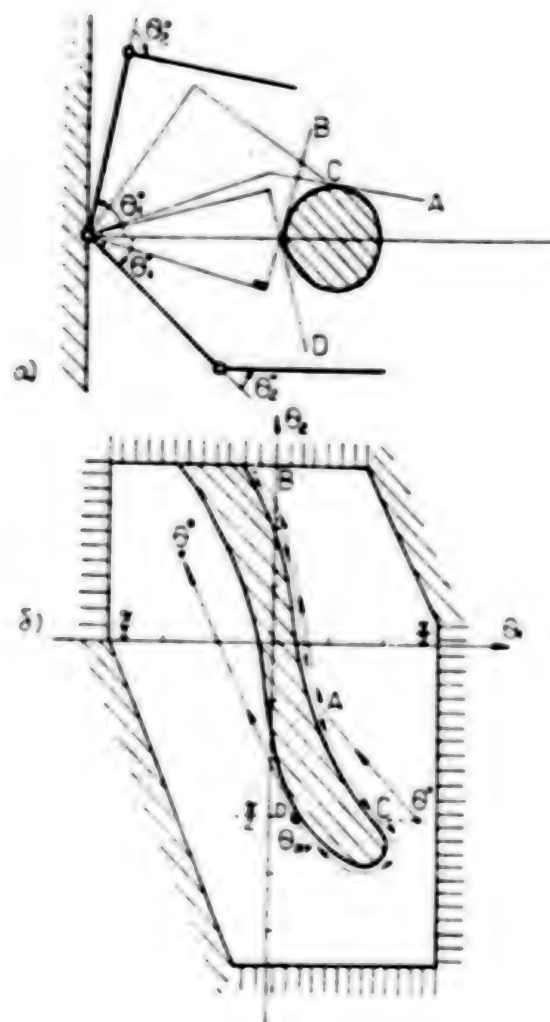


Fig. 4

As may be seen from Fig. 3, such logic rules make it possible to find a path to the target in fairly complicated labyrinth-like environments. We stress that here movements are considered in an entirely unfamiliar environment and, therefore, the first path on the basis of only new data may be "unoptimal," in particular, it depends on selecting the initial direction of the by-pass. Working in a given stationary environment, the robot may be trained, for example, by repeated movements to the same target point not to enter "closed" depressions in the forbidden zone. It is important that



with such an approach, building the "world's model" is achieved not by preserving the entire forbidden zone  $\Sigma$ , but remembering only its specific points which are essential for laying an efficient path to the target. This makes it efficient and indeed expedient to represent knowledge in space  $\Theta$ , which, as indicated above, has an advantage over spaces  $Z$  and  $E^3$  from the viewpoint of planning manipulator movements.

Fig. 4a shows sequential positions in the working space of the manipulator that by-passes the cross-hatched obstacles in the presence of limitations

$$-\frac{5}{6}\pi \leq \theta_i \leq \frac{\pi}{2}$$

(an example of a manipulator with two degrees of mobility was taken for illustration). The corresponding trajectory of the image point on plane  $\Theta = (\theta_1, \theta_2)$ , plotted in accordance with the described algorithm is shown in Fig. 4b. For obtaining efficient movement, it is not necessary to know either the global view of the environment with obstacles in the working space, nor the position of those points of the manipulator links that may be found in the danger zone. It is sufficient to have a sensor that signals the fact of approaching obstacles and memorizes a "more advantageous" direction for by-passing the  $\Sigma \subset \Theta$  zone and the permitted point of break  $\theta_{cr}$ , in order that on repeated movement to the same target, it will follow the path indicated in Fig. 4b by a broken line.

The considered algorithms when used in the HCS permit efficient disparrelling of the computer functions: differential equations (6) are solved and functions  $S(\theta)$  are formed, that provide a "local bulge" in the boundary of zone  $\Sigma$ , in the analog part of the HCS; the digital part is used to control the logic for cutting-in  $S(\theta)$  and to build a "model of the world" in space  $\Theta$ . This makes it possible to generate programed movements not only in real time, but also in accelerated time scales.

Signals formed in unit I of program changes in time of generalized coordinates, of their derivatives, as well as of required nonlinear functions, may be used for calculating programed control in unit II (Fig. 1). If it is found that inequalities (3) are violated in this case, it is immediately possible to limit the terms of the right part of (6) according to model (2), in order that the generated combination  $\theta, \dot{\theta}$  and  $\ddot{\theta}$  be handled by drives without distortions. Then any significant deviation of the actual movement from the programed one will attest to the necessity of the adaptive tuning of unit II with respect to changes in the dynamic characteristics of the object not taken into account (for example, when the manipulator begins to carry a heavy load of unknown weight). The accelerated solution in the analog part of the HCS of the direct dynamics problem by equations (2) (unit IV) opens up wide possibilities to identify the parameters of the model and the adaptive tuning of the system.

Possibilities of the combination control system were investigated in machine and semireal experiments with an actual manipulation robot in a hybrid simulating complex described above. Fig. 5 illustrates the errors in finishing-off the programmed trajectory of a transition of one of the degrees of mobility of the manipulator with a load in a given position in the vertical plane when being controlled by a position tracking system by means of a combination control system model.

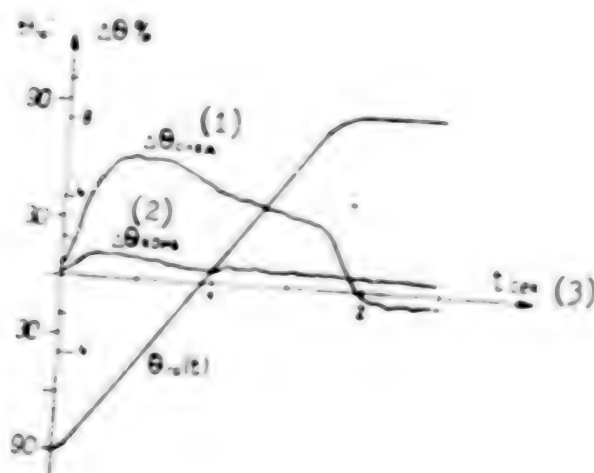


Fig. 5. 1 -- tracking; 2 -- combination; 3 -- seconds.

#### Conclusion

The obtained results shows the efficiency of the hybrid algorithms for the combination control of manipulator robots, as well as the great promise of a hybrid simulating complex for investigating information control robot systems.

#### BIBLIOGRAPHY

1. Perfil'yeva, I. M.; Petrov, A. A. "On Utilization of Hybrid Computer Systems for Simulating Robots Manipulators." In book, "Use of the Hybrid Computer System HCS-100 for Solving Control Problems." Edited by B. Ya. Kogan. Izd. Institute of Control Problems, Moscow, 1975.

2. Kogan, B. Ya.; Petrov, A. A. "On Possibility of Using Hybrid Computer Systems for Simulating and Controlling Robots Manipulators." In book "Annotations and Reports of the International Conference on Artificial Intelligence," Repino, 1977. Izd. Scientific Council on Comprehensive Problem of Cybernetics" AN SSSR. Moscow 1977.
3. Petrov, A. A.; Perfil'yeva, I. M. "On Controlling Robots-Manipulators" Movements by Hybrid Computer Systems." In book, "Reports of 7th All Union Conference on Control Problems." Izd. of Control Problems Institute and Technical Cybernetics Institute of AN SSSR, Minsk 1977.
4. Kogan, B. Ya.; Petrov, A. A. "Hybrid Computer Systems and Robot Simulation." In book, "Scientific Problems of Robot Equipment." Nauka, 1980.
5. Kogan, B. Ya. "Hybrid Computer System of the Third Generation and Prospects of Their Development. In book "Reports of Fifth All Union Scientific Engineering Conference "Further Development of Analog and Analog-Digital Computers." Sov. radio, Moscow, 1977.
6. Popov, Ye. P.; Vereshchagin, A. F.; Zenkevich, S. L. "Manipulating Robots. Dynamics and Algorithms." Nauka, Moscow 1978.
7. Medvedev, V. S.; Leskov, A. G.; Yushchenko, A. S. "Systems for Controlling Manipulating Robots." Nauka, Moscow, 1978.
8. Takase, K.; Inoue, Kh.; Sato, K. "Design of a Multilink Manipulator Controlled in Accordance With Torque." In book "Remote Controlled Robots -- Manipulators. Mir, Moscow 1976.
9. Pol, R. "Simulation, Trajectory Planning and Control of a Robot Manipulator. Nauka, Moscow 1976.
10. Kogan, B. Ya.; Petrov, A. A. ; Perfil'yeva, I. M.; Tulepbayev, V. B. "Hybrid algorithms for Controlling Movements of a Robot Manipulator." In book "Reports of All Union Conference on Robot Technical Systems" (Vladimir). Nauka, Moscow, 1978.
11. Pieper, D. The Kinematics of Manipulator under Computer Control. Stanford AI Project, Memo 101. Stanford, Ca. 1969.
12. Kobrinskiy, A. A.; Kobrinskiy, A. Ye. "Plotting Optimal Movements of Manipulation Systems." MASHINOVEDENIYE, No 6, 1976.
13. Korenev, G. V. "Purposeful Mechanics of Controlled Manipulators." Nauka, Moscow, 1976.
14. Kulakov, F. M. "Organization of Supervisory Control for Robots - Manipulators." Izv. AN SSSR, Technical Cybernetics. No 5, 6, 1976.

15. Malyshev, V. A.; Timofeyev, A. V. "Algorithms for Plotting Programmed Movement of a Manipulator Taking into Account Limitations and Obstacles." Izv. AN SSSR Technical Cybernetics, No 6, 1978.

16. Widdoes, C. A. Heuristic Collision Avoider for Standard Robot Arm. Stanford AI Project, Memo CS 227, Stanford, Ca. 1974.

17. Orlyanskiy, V. Yu.; Perfil'yeva, I. M., Tulepbayev, V. B. "Hybrid-Oriented Algorithms for Forming Programmed Movements of Robot Actuators." In book "Use of Computers for Controlling Complicated Objects." Izd. Institute of Control Problems. Moscow, 1978.

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## ROBOTICS

### BRIEFS

**ASSEMBLY ROBOTS--Kursk--**Bearings assembly, including the assembly of bearing retainers, has traditionally been done manually. But these two assembly operations are now being done by a robot-engineering complex in the No 2 grinding-assembly shop at State Bearing Plant No 20. The robot assembles a thousand parts in 45 minutes, replacing four [female] workers working two shifts. The complex was developed by the plant robot design bureau. This year, another four such complexes will go on stream in the shop, freeing a whole brigade of assemblers [female] from monotonous, unproductive labor. [SI correspondent Yu. Antropov] [Text] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 10 Feb 84 p 2] 11052

**ROBOT MACHINE OPERATORS--**Robots standing watch in the machine shop at the Kharkov Transport Machinebuilding Shop imeni V. A. Malyshev are working very fast and accurately. Each services three or four machine tools with numerical programmed control, delivering blanks to the work station, loading them and removing the finished output. Scientists from Moscow, Zaporozhye and Kharkov helped plant designers "teach" the machine many occupations. They developed a noiseless electromagnetic motor for the robot and endowed the manipulator with unique abilities. For example, if a person suddenly appears within the work area, the robot immediately stops, so as not to injure him. When the obstacle disappears, it continues its activity without a break in the preset program. Specialists think this gantry multiple-machinetool robot could be used at many enterprises having machine tools with numerical programmed control. The manipulator replaces a brigade of operators. Industrial robots of various designs are being introduced increasingly extensively at Kharkov enterprises. They are already working as smiths, assemblers and casters of hot metal, as stamp operators and loaders, and are working successfully with welding robots. [RATAU correspondent L. Zamyatin] [Text] [Kiev RABOCHAYA GAZETA in Russian 10 Mar 84 p 2] 11052

**ROBOT PHOBIA--(ATEM)--**The robotization of production is a complex business which must be carried out without haste, so as to not compromise it. "Robot phobia," the psychological unreadiness of certain managers to introduce automated manipulators with programmed control, is also capable of causing considerable damage. The importance and urgency of this problem were the focus of attention at a republic scientific-practical conference, "Robot Engineering and Production Robotization," which was held on 27 January in Kishinev. It was organized by the Moldavian Communist Party Central Committee, Moldavian SSR Gosplan, MSSR State Committee for Labor, Moldavian SSR Academy of Sciences and the republic scientific-labor organization council. Participating in the conference were prominent



scientists and specialists in the field of developing and applying robot technology from Moscow, Leningrad, Nikolayev and Odessa, as well as leaders from republic ministries and departments, scientific institutions, associations and enterprises, and representatives of party and trade-union organs. The reports and communiques examined questions of developing and introducing robot equipment in various branches of the national economy, using it to improve working conditions and increasing labor productivity, engineering support for production robotization and the tasks of party and public organizations in implementing this. Taking part in the conference were P. I. Shapa, Deputy Chairman of the Moldavian SSR Council of Ministers, I. T. Gutsu, head of the industry department of the Moldavian Communist Party Central Committee, and L. F. Kulyuk, deputy chairman of the republic Gosplan. [Text] [Kishinev SOVETSKAYA MOLDAVIYA in Russian 28 Jan 84 p 2] 11052

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